THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE INSTITUTION OF ELECTRICAL ENGINEERS.

WITH the annual general meeting on Thursday last week the working session of the Institution was closed in perfect harmony. From the point of view of, probably, a large number of members, the *pièce de résistance* was the President's announcement of the decision of the Council to effect a material reduction in the annual subscriptions of Members, Associate Members, and Graduates. It is only too true that under the existing conditions the cost of maintaining one's membership of professional and other societies is an appreciable burden, and while there is much to be said for the principle enunciated by Bacon and quoted by Mr. Ll. B. Atkinson in 1920—that every man is a debtor to his profession—we think the Council has done wisely in lightening the pressure of that obligation. The subscriptions were increased for a specific purpose—namely, to cope with the increased expenditure resulting from changed conditions; obviously, when altered circumstances enabled the additional revenue thus obtained to be regarded as surplus to the current requirements of the Institution, the Council had no authority to devote such surplus to purposes that were not discussed and approved when the increase was authorised.

Hence, even Mr. F. W. Purse, the doughty protagonist of small towns and men of modest means, was fain to congratulate the Council on the relief afforded, which, he admitted, went further than he had contemplated asking for; and Mr. W. R. Cooper, at whose instance provision had been made for such a reduction, saw his action justified in the event. Had no concession been made, no doubt the matter would have resulted in "resistance" of another sort.

The meeting was noteworthy also for the presentation of a portrait and bust of the late Professor Silvanus P. Thompson, Past-President, together with his collection of books, to the Institution, which, as well as the whole of the electrical industry, never had a more faithful friend or a more worthy servant than he. By a happy coincidence, Prof. Elihu Thomson, who claims to be 70, but does not look 50, was present and expressed his high appreciation of the merits of his old friend.

The membership of the Chartered Institution is now approaching 11,000, having increased by 4,298 since the war; besides being the largest engineering body in this country, the Institution is steadily gaining in prestige and is performing a vast amount of excellent work for the benefit of the electrical industry, not least of which is the promotion of research in collaboration with the B.E.A.M.A. It has repeatedly been pointed out that the benefits obtained by well-conducted research are out of all comparison with the cost entailed, and of this statement the report on the heating of buried cables, which was recently published, is a striking example, which by no means stands alone. The Institution also, through its Local Centres and Sub-centres, is bringing electrical men together in all parts of the country to their mutual advantage; no feature of its development more surely indicates that it is a healthy and living organism than the continual increase in the number of these local foci of activity and growth. But they

bring with them new problems, and it is pointed out in the report that the repeated reading of the same technical paper at Centre after Centre is detrimental to the attendance at the meetings, a statement which we can readily believe. To our mind it would be far better to have many short papers, provocative of lively discussions, at the Local Centres than to send a few more important ones on tour to be talked to death. This is a matter to which the Council and the Local Committees should devote most careful consideration in preparation for the new session.

At the moment a large contingent from the Institution is holding what should be a very successful and enjoyable Summer Meeting in the North-West, which with reason claims to be the most important engineering centre in the country; the weather, as we write, is fair, if not ideal, and if it holds good for the tour in North Wales, the party will indeed be lucky.

Multiple Circuits.

One of the petty restrictions with which the use of electricity by the householder is still hampered in many areas of supply—even Metropolitan areas—is the necessity of using separate circuits if he wishes (and who does not?) to avail himself of the lower tariff for heating. In these enlightened days we cannot but regard such a requirement as out of date and absurd in the extreme; there are numerous examples of the successful adoption of a two-part tariff, comprising a fixed quarterly charge and a single low price per kilowatt-hour without regard to the purpose for which it is used, and the Electricity Commissioners have secured power in the Act of 1922 to dispense with the flat rate which was formerly compulsory. It is easy to talk about plugging a kettle or suction-cleaner connection into a lamp-holder, but what a tiresome nuisance it is to take out the lamp, put it carefully into a safe place, plug in, and afterwards reverse all these proceedings! Again, if one has a heating circuit and a portable lamp, the two must never be associated—so, instead of slipping a lighting plug into a heating socket, one must either go through the performance described above, or provide wall sockets for lighting.

We are prompted to draw attention to the matter by an inquiry from a correspondent regarding the proper provision to be made for accessories taking a small current, such as suction cleaners, shaving-pots, &c., when the heating circuit is wired and fused for heavy-current radiators. If wall sockets are provided for portable lamps, they may be used also for the small-current accessories; but why should a consumer who has incurred the expense of installing a heating circuit be obliged to pay at lighting rates for the use of a suction cleaner or other device which is generally used in daylight hours?

On the other hand, if he equips these devices with plugs large enough to fit the 20-ampere radiator sockets, our correspondent points out that the 20-A fuse provided for the radiator is altogether unsuitable for the device consuming only one or two amperes.

It would be possible to fix a 5-A fuse and socket as an extension from a 20-A socket, at small expense, thus meeting the difficulty, but to our mind the trouble is really imaginary. We look upon the 20-A fuse on the distributing board as protecting the wiring of the circuit associated with it from overheating—not necessarily as protecting the apparatus that may from time to time be connected to the wall-sockets. Provided that no reduction of cross-section is made in the whole of the wiring of a circuit, a single d.p. fuse at its origin adequately protects the whole circuit. The primary purpose of the fuse is to protect not apparatus but wiring, and therefore there is no objection to plugging a 1-ampere-device on a 20-ampere circuit, if the nature of the tariff permits of it.

It will be objected, of course, that the flexible cord is not protected, being usually of smaller cross-section than the fixed wiring; on the other hand, when a wall-socket is in use, the flexible is almost always under observation, and it will carry a far heavier load than is specified as the "maximum current permissible" under the I.E.E. Rules without attaining a dangerous temperature. Moreover, the cost of heavier flexible is trifling compared with the convenience of being able to plug in any apparatus anywhere. Our own experience is that a fault occurring on a small portable device is either an open circuit, which involves no risk, or a short circuit, which immediately blows the circuit fuse. Our views may be unorthodox, but it does not necessarily follow that they are wrong. Perhaps our readers will deal with them.

Big Ideas Necessary for South American Trade Expansion.

We have referred on several occasions to the activities of the British and Latin-American Chamber of Commerce. An organisation which exists for the purpose of promoting and extending commercial and financial relations between the United Kingdom and Latin-America has unlimited opportunities for rendering invaluable service to British industries, and it is therefore deserving of thorough-going support. It is satisfactory to note that the membership has increased by eighty during the past year. According to a statement made by Sir James Kemnal (of Babcock and Wilcox, Ltd.) at the fifth annual meeting which was held in London last week, a representative was recently sent out to South America to expound the work of the Chamber, but Sir James, we are glad to note, was very emphatic in his statements about the need for far larger action. In his view, if the Chamber is to be a link between buyer and seller—between one country and another—they as members of the body must spend money more generously on their business adventure. They must not limit their activities to offices, propaganda, and a very worthy permanent exhibit, but must send out at least a dozen men to cover the vast South American countries hunting up business. There is a danger that when we talk of these far-stretching territories we shall think in too limited a way, resting content with the sending of one man to explore, nurse and develop in a trade sense lands that take an average man a year or so merely to see without cultivating relationships or business connections. British traders and others of the past had a spirit of daring adventure in their enterprises when nobody else was in the field. Critics are constantly comparing our export trade-seeking activity with that of foreign competitors showing our policy to be a pitifully little one. If we can see our way to enlarge our activities either through the instrumentality of a Chamber such as we have referred to, or by co-operative specialised trade sectional movement, or by strong go-ahead individual action such as has made the great names of British engineering businesses known in overseas markets in the past, the outlay should come back manifold in the course of a few years. British industrial influence abroad would be more powerful, more permanent, and less susceptible to attack, and the coming years should bring much added employment to the works of the Homeland from parts of the world which cannot longer delay development. We have got to get away from the mistaken policy of spending a few pounds on propaganda through fancy channels. It costs something to become known and to keep a name and manufactures before the mind of potential purchasers in other countries. Experience has proved the value of certain media acting either as forerunners or in co-operation with live and experienced travellers. A name must be made familiar through constant and consistent publicity which reaches specialised buyers; the makers' goods must be demonstrated by permanent exhibits maintained within fairly easy access; and the makers' live spokesmen must be known and respected. To do all these things effectively in a large market like South America must cost money; and those who prefer, or are

perforce compelled, to unduly limit their expenditure must be prepared for only a trickle of trade to come to their door while the flood goes elsewhere.

Overseas Trade Committees.

It is announced that the Parliamentary Secretary to the Department of Overseas Trade has appointed some additional members to his Advisory Committee. Perusal of the names and business interests of the complete committee indicates that the iron and steel trades have a strong representation. We do not take any exception to that circumstance, for those trades are of vital concern in connection with British trade overseas, but we are inclined to wonder why there is so little representation of the great electrical engineering and allied industries. Mr. W. L. Hichens is described as chairman of Cammell Laird & Co., Ltd., and as deputy-chairman of the English Electric Co., Ltd. The latter is the only direct electrical reference so far as we can gather in the Committee membership, and while we do not under-estimate its business weight we must confess that we should have liked to see the services of our electrical manufacturing and trading interests more freely taken advantage of by the Department of Overseas Trade. But perhaps there are reasons that we wot not of. Sir Charles Mandleberg, of Manchester, appears in the list as chairman of the Overseas Committee of the Federation of British Industries, and we presume in that way may be considered an indirect representative of the B.E.A.M.A. The weakness about committees of this kind, as they appear to the mere outsider, is that they have to be composed of experts with wide experience who are big men with large and varied interests, and who for the very reasons which call for their appointment, have little time to spare for committee work.

Commercial Arbitration in Foreign Trade.

On several occasions in recent months we have referred to this subject with special application to the Court of Arbitration established in connection with the International Chamber of Commerce in Paris, which was inaugurated by the President of the French Republic a short time ago. Quite independently of the action of the Paris Chamber, the Economic Committee of the League of Nations, as was mentioned some time ago, has been working in a similar direction with a view to inducing the States' members of the League to adopt measures to promote the use and secure the practical efficiency of clauses in private commercial contracts providing for arbitration. The Economic Committee has now prepared a draft protocol on the recognition of arbitration agreements. Copies of the document have been circulated by the Council to the States' members of the League, and it is proposed to open this protocol for signature by all the States that are able to accept it at the next meeting of the assembly of the League. As the protocol will be subject to the ratification of accepting States, it will consequently become legally binding on the subjects of the ratifying countries, although any contracting party may denounce the protocol on giving one year's notice.

A Brave Man's Despair.

In these piping times of peace, when suicides are far too common, a report in the *Star* of May 28th appears to require some public attention. The case described is that of a mining engineer, David Hermann Lawrence, aged 50, who gave up his post in Mexico upon the outbreak of war and came here to join up. He was rejected for service, and had since been doing odd jobs, but failed to get any kind of regular employment. He appealed to the Government for a grant to get him back to Mexico, but was unsuccessful. He could not obtain work, and to beg he was ashamed. Neither the official to whom he applied for the grant nor anybody else appeared to suggest any way of getting over the difficulty, with the result that he shot himself. The Coroner, recording a verdict of the usual character, remarked that it was extremely hard that the deceased was not provided with the means of returning to his employment in Mexico.

For our part we think so too, and we venture to ask how it was that this man was not referred either to the Professional Classes Aid Association or to the Prince of Wales's Fund. These two institutions may be doing most excellent work in a quiet way, but we think that there should be some definite advertisement of their activities in order that men in such straits may know where to go. Judging from the facts set forth in the *Star*, we should imagine that this was a case where a temporary loan would have saved a life and a great deal of misery, and eventually would have been faithfully repaid.

Our excuse for commenting on the matter is that this poor patriot belonged to the engineering profession. Had he been an electrical engineer, either the Institution Benevolent Fund or the Electrical Trades Benevolent Institution, if applied to, would certainly have assisted him.

Hydro-Electric Works in Italy.

The development of hydro-electric works in Italy is shown by an increase in the capacity from 1,500,000 h.p. in 1915 to 2,200,000 h.p. in 1922. According to a report from Rome, no fewer than 67 new works of a total of 300,000 h.p. have been brought into operation in the past two years, while a beginning was made in the same period with a further 51 works with 27 reservoirs, which are to yield 364,000 h.p. In addition, still further hydro-electric works are projected, particularly in the province of Trient. The Italian Government recently concluded an agreement with the Sila company and its associated banks, under which the State will participate to the extent of 60,000,000 lire in the undertaking, which is to supply 1,000,000,000 kWh annually in Lower Italy, especially Calabria and Apulie.

It is assumed that within four years Italy will have at disposal hydro-electric works of at least 3,000,000 h.p., or twice the power available in 1914. Down to the end of last year the share and loan capital invested in these undertakings had reached 3,000,000,000 lire, and an addition of 2,000,000,000 lire will be made in the next four years through the establishment of the other works now in prospect. A bounty of 40 lire per horse-power of plant to be installed was promised a few years ago by the Government of the day to encourage the construction of new hydro-electric works, but although machinery of 300,000 h.p. has been erected in the meantime, it is stated that the promise has not been kept in any single case, development obviously proceeding independently of any State subsidy.

Industrial Lighting.

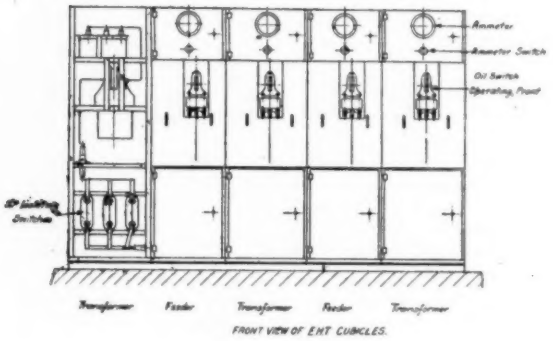
The subject of industrial lighting continues to arouse much interest, and in his paper before the Royal Society of Arts on May 16th, Mr. Gaster presented some useful data showing how closely bad lighting and the occurrence of accidents, both to persons and material, are related. Electrical engineers, one supposes, fully appreciate the benefits of good lighting in factories. It is chiefly the directors of industrial companies and managers who require education on this point. The efforts that are being made to interest Joint Industrial Councils in the subject should therefore prove of great value. There seems to be a general recognition that the time is ripe for some judicious reference to lighting to be included in the factory legislation of this country. It is therefore gratifying to note the assurance of Sir Malcolm Delevigne (Assistant Under-Secretary of State, Home Office), who presided at the meeting, that the next Factory Act will contain suitable provisions for adequate lighting in factories, based on the recommendations of the Home Office Departmental Committee. As we have previously pointed out, these recommendations have been framed with great care, and can be easily complied with, and we have no doubt that they will be willingly accepted as in the interests of both employers and workers.

D

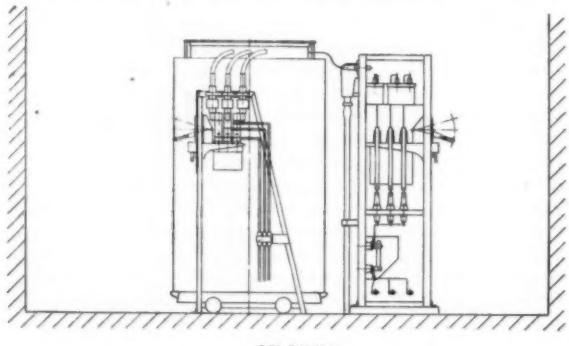
THE ARRANGEMENT OF STATIC TRANSFORMER SUB-STATIONS.

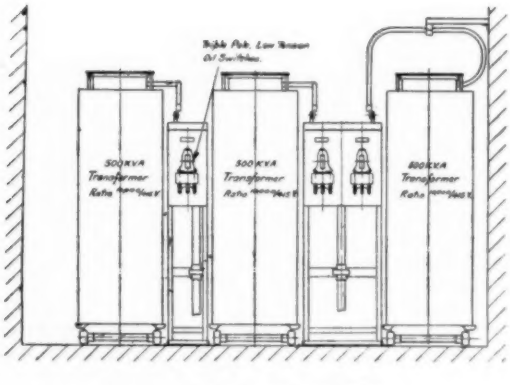
E.H.P. Switchgear with Inverted Busbars.

THE drawings which we reproduce below, supplied by Messrs. Johnson & Phillips, Ltd., show four views of a sub-station specially designed to economise space. This arrangement is very suitable for those sub-stations which are fed by h.p. or e.h.p. feeders and which step down through static transformers to 440 volts or some such voltage. The usual method of arranging these sub-stations is to place the h.p. switchgear against one end wall of the sub-station and the l.p. switchgear against the opposite end, the transformers being in the centre of the floor between the two switchboards and being connected to them by means of high- and low-pressure underground cables. This arrangement takes up a good deal of space, and therefore involves a large and expensive building.

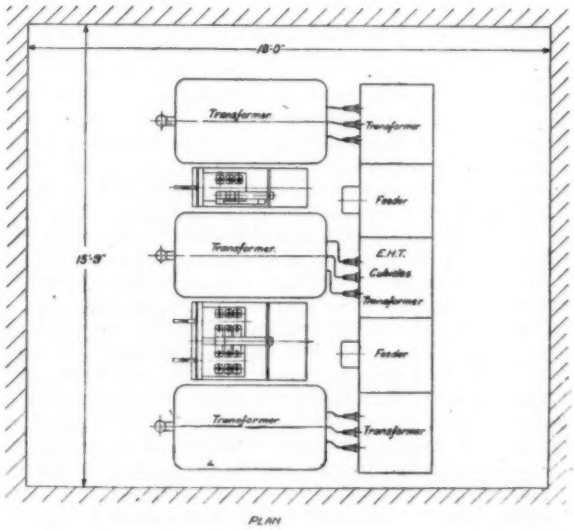


FRONT VIEW OF E.H.T. CUBICLES.


SIDE ELEVATION.



VIEW SHOWING MAIN L.T. OIL SWITCHES.



PLAN.

By the arrangement shown in the drawings, which the firm has recently utilised in several sub-stations for its customers, the transformers and switchgear are all brought close together in the middle of the sub-station, the only clearances required being a three-foot passage-way between the h.p. board and the wall for operating purposes, and another passage-way of four or five feet between the transformers and the opposite wall in order to allow of the handling or removal of the transformers.

From the side elevation it will be noted that the incoming h.p. feeders are brought to the back of the h.p. cubicles and run up to the top of their respective cubicles by means of right-angle cable boxes, and are then connected through the usual current transformers, oil switches, and isolating switches to the bus-bars placed in the bottom of the cubicle. The h.p. cubicle for the control of the transformer is similarly arranged, the power being taken from the bus-bars at the bottom through isolating switches, oil switches, current transformers, and out of the top of the cubicle at the back through the porcelain bushes straight to the transformer h.p. terminals, thus saving expensive h.p. underground cable, junction boxes, &c.

The low-pressure transformers are controlled by l.p. automatic oil switches mounted on angle-iron framework immediately between adjacent transformers, thus rendering the l.p. connections as short as possible.

The l.p. feeders can be arranged in various ways. A limited number can be placed between the transformers adjacent to the l.p. transformer switches, or they can be placed in any of the following positions:—On the wall opposite the transformers; on the floor above, provided the building is a two storey one; or in an adjacent building at the side. Installations have been carried out embodying all these principles, and for those sub-stations in which the feeders are placed on the floor above or in an adjacent building, the l.p. bus-bars have been run immediately above the static transformers, and thence they are taken either to the floor above or to the next chamber, according to circumstances.

H.p. and e.h.p. voltages of 2,200, 3,300, 6,600, and 11,000 volts, and l.p. voltages up to 650, have been dealt with on this principle.

As the arrangements set forth above are somewhat novel, and have not been adopted to any great extent, it is thought that the particulars will be of interest to those responsible for sub-station layouts.

THE ORGANISATION OF THE ELECTRICAL INDUSTRY.

By "AN OLD FRIEND."

THE new policy proposed by the Electrical Contractors' Association marks a step forward in a matter of such great import to the whole electrical industry that a few observations by one of the "Old Brigade" may be appropriate, if only to furnish a start to some useful discussion as to the details of this policy, which in some respects may be considered revolutionary in its effect, whether intended or consequent.

As a preliminary, it will be helpful if we trace the evolution of the various branches of the industry as they now appear, because in that way we may be able to see in what manner they assist or conflict with one another, and what steps should be considered or taken to achieve the objects in view, *viz.*: First, to increase the general uses of electrical plant and apparatus, and secondly, to improve the prosperity of all the classes who earn their livelihood by or from the industry.

In the early days the only man concerned was the manufacturer, who designed and made all his apparatus, sold, and installed it. Gradually there was evolved a set of men who specialised in the invention and manufacture of the various kinds of fittings, accessories, instruments, &c., necessary for the complete installation, but these men all had the necessary technical and scientific knowledge appertaining to the whole industry and were thus better equipped in a comparative sense than is the case to-day. They also created new instruments, &c., to meet the needs of the industry, as the absence or want of these became apparent from experience and practice.

The evolution of the contractor, as we now understand him, was a slow one. At the first, he confined himself to the fitting of electric bells, alarms, and such-like, and even in this case, he sometimes made some small portion of the apparatus he used. In most cases this business formed part or a branch of another and larger business, principally what is known as plumbing or sanitary engineering, hence the contractor of the early days was usually a substantial man in the financial sense, for the reason that his principal income was derived from his main business.

As the use of electric lighting became more general, and generating stations were provided, he added wiring and the sale of fittings to his business and became an electrical contractor in the full sense of the term, as differing from his former appellation of electrician or electric bell fitter. As time went on and the electrical portion of his business increased, he in some cases ceased his former or other branch, and devoted himself entirely to the electrical work. Many of the most important and most respected members of the contractors' branch of the industry laid their foundation in this manner. They are among the most enlightened and businesslike, no doubt due to their early and thorough general training and hard-earned experience.

The E.C.A. report and the accompanying recommendations without doubt come at an opportune moment, although long after they were due and needed. There never was a time when the status of the "contractor" was lower. Whilst it may be taken as a truism that 80 per cent. of the "manufacturers" are "good," the other 20 per cent. being "doubtful" or "bad," the proportions for the "contractor" branch of the industry may be taken as the same figures reversed, *viz.*: 20 per cent. "good" and 80 per cent. principally "no doubt."

The reasons for this are plain and well known. This 80 per cent. is largely made up of what the French would call "*anciens*" wiremen, wiremen's mates, and such-like who have ceased their former calling for various good or bad reasons. They have started in business for themselves with a capital of a few pounds, or often with less than nothing. They have been enabled to do this mostly by the silly and reprehensible practice of the wholesaler or factor, who has invariably allowed such men credit out of all proportion to their status, with the inevitable result of bad debts and a lowering of the standard of the whole "contractor" class. This evil is of long standing, but has steadily become worse.

If the E.C.A. will, out of its recommendations, find a remedy for only this defect, it will find that most of its other disabilities will more readily and easily be dealt with; in fact, many of them will right themselves.

The first serious example of the wholesaler, factor, or supply house was the firm of Woodhouse & Rawson, established in the early 'eighties. This firm manufactured a certain number of articles and stocked the goods of nearly all other makers. It was a supply house in the real sense of the word. It kept in stock quantities of each kind of goods probably far larger than could have been obtained directly from the actual manufacturer; it bought wholesale in the full meaning of the term, and was of equal assistance to the manufacturer and the contractor. Its methods in this respect would serve as a useful example at the present time. Unfortunately it came to an untimely end from causes outside the genuine portion of its business. R.I.P. The wholesalers of those days bought in very large quantities—they had to, in order to obtain low prices from the manufacturers—but from information gleaned in a general way, it appears that the average wholesaler of the present day expects from the manufacturer his lowest or most favourable price (calculated for large quantities) for the wholesaler's most suitable or lowest quantity, which (as Euclid used to observe) is absurd.

The importer established himself in the early days of the industry, not for the purpose of competing on a price basis, but in order to introduce goods which were not produced in this country or which could only be obtained with great difficulty or at a prohibitive cost. Such goods were porcelain insulators, insulating material, lamps, glassware, electric jewellery, toys, batteries, bells, pushes, &c., and the country of origin was almost entirely France. It was not till a much later period that anything electrical was imported from Germany, and still later America.

We will now examine the recommendations of the E.C.A., criticising them as far as possible from an unbiased point of view.*

1 & 2.—These are both very worthy objects, but can only be achieved by shepherding into the Association a large majority of the contractors and obtaining such recognition from the other classes that the Association will become powerful enough to wield a useful and profitable influence over the whole industry.

3 (*a*).—The middleman is always the bugbear of every industry. He will never be eliminated; he is a necessary evil. On the other hand, he may be able to make himself a power for much good, and as his existence depends entirely on his own efforts and the extent of the service he can render, he need hardly be considered, because the remedy lies entirely with the contractor. If the contractor can or is willing to buy in suitable quantity, there is no manufacturer who is fool enough to refuse his order.

(*b*).—The contractor has been allowed or encouraged to buy in very small or hand-to-mouth quantities. It is obvious that a contractor will not keep large stocks if he knows he can obtain his supplies as he actually needs them and at the same price. It would be quite a simple matter for several contractors to buy co-operatively and thus gain considerable advantage.

4 (*a*).—There is more in this than meets the eye. The

* The recommendations were printed in the ELECTRICAL REVIEW of May 4th, 1923, p. 689.

writer's opinion, based on experience, is that the comparatively slow progress of the industry in general, so far as the use of electricity by the public is concerned, is due in great measure to the apathy of the contractor in placing before the public the advantages, &c., of the various uses of electric power. Any manufacturer of new appliances will confirm this statement. The average contractor is quite willing to book the order of a customer for such an article, but he will refuse to have samples in his showroom and endeavour, by his own efforts, to make a business in them.

(*b*).—As soon as the contractor shows that he is willing and capable of carrying out (*a*), then the manufacturer will discontinue his dealings direct with the user. The manufacturer is fully alive to the advantages of supplying his goods to the user through the contractor or retailer, but it is hardly to be expected that he is going to incur great expense in advertising, &c., and then pay doubly by allowing large discounts to a middleman, for simply delivering the goods by a roundabout method.

The result (*b*) must arise from (*a*).

5 (*a*).—The only method by which the Association can accomplish this will be the commonsense one of its contractor members becoming such proficient salesmen and making themselves so useful and indispensable to the manufacturer that he will be only too pleased to fall in with any reasonable wishes they may express. No other method will accomplish this end.

(*b*).—No sensible manufacturer (and most of them are sensible) would supply the user directly at the same price as he would the contractor. The wording of this clause can hardly be considered conciliatory.

6.—The Association must support price maintenance. It is a matter of vital expediency. The bane of the electrical industry has been the senseless system of price cutting, as shown by the ridiculous estimates put forward for wiring. The idiocy of price cutting is as bad as the greed of profiteering, and from the "trade" point of view much worse. The only one who gains a temporary advantage is the buyer, and even he may lose in the inevitable harm which always results from such a practice.

7.—This principle is a good one, and, provided the relation between (*a*) and (*b*) is not too great, the adoption of such a principle can only be productive of all-round good effects.

8.—Nothing but good can result from such a policy, which might properly have taken first place in these recommendations.

9.—There is much to be said on both sides. The trader who possesses honourable traits, and conducts his business in a methodical manner, will always obtain advantages far outweighing any cash discount. On the other hand, the offer of a cash discount results more often in the slack payer paying less promptly than he might otherwise, because he reasons, quite correctly, that, having lost his right to cash discount, he may as well take it out in time.

10.—This is quite a correct and necessary point.

11.—This is a very worthy object, and, in the writer's opinion, the best results will be obtained by a liberal interpretation, adoption, and vigorous effort in favour of clause 4 (*a*).

12.—The only remark the writer would make is in respect of the definition of "wholesale trader." In his opinion, a Government Department or any other body which does not buy in quantity should not be entitled to trade discount.

13.—This provides for the exception taken as above.

14.—This should provide ample scope for the energies of those members of the E.C.A. skilled in the art of debate.

15.—The classifications appear to be correct and inclusive, but it would improve the status of the contractor if the technical qualification were made more definite. It is manifestly more necessary that the contractor or "installer" should have a thorough technical knowledge and experience than the manufacturer, at least the manufacturer of such articles as accessories, fittings, &c., whereas the reverse is the general case.

16.—Excellent.

The foregoing comments are the personal opinions of the writer only, but are based on his experience as manufacturer, wholesaler, contractor, and consultant, extending over a period of some 35 years.

FACTS.

By T. J. MONAGHAN, B.Sc., A.M.I.E.E.

"FACTS," wrote Burns, "are chiels that winna' ding, an' downa be disputed," which may be roughly translated by: Facts are things that cannot be overthrown or disputed; they are stubborn things, for, impossible to overthrow, they are by no means easy to establish. Since engineering practice is based on facts, any information as to the pitfalls in the path of the fact seeker is likely to be useful, and the following reflections of a frequently-disappointed seeker after engineering truths, and some suggestions arising therefrom, may enable other pilgrims to avoid some of the obstacles that strew the road to knowledge.

A fact is something real, something true, something not merely a matter of supposition, and while metaphysicians are still striving to grasp the fundamental nature of reality, the engineer soon learns from experience that scientific laws govern the phenomena with which he is concerned, and that his conduct must be guided by scientific facts, not by fancies, unless disaster is to be risked. Knowledge may be defined as justified conviction; conviction alone is not necessarily knowledge, it may be cocksureness. As regards material things, knowledge reaches us by way of the senses; from the external world, in ways as yet unknown (for the process intermediate between, for example, sound waves in air striking the drum of the ear, and so affecting the aural nerve, and the sensation of hearing that follows, is a profound mystery), we receive mental impressions of colour, size, taste, &c.; with these sense impressions as our raw material we draw inferences by the aid of reason, so coming to conclusions which will be correct, and therefore knowledge, if our reasoning has been sound, but which will be erroneous if our reasoning has been unsound; such incorrect inferences are too often confidently asserted as "facts." Facts safely stored in the memory constitute that most valuable acquisition—experience.

The sense of sight is perhaps that most used in the collection of engineering facts—it is employed in taking all measurements, and without measurements engineering as an art would perish—and the aim of the observer must be to see everything of importance, and to see it correctly. Cultivate, then, the seeing eye by calling to your aid a spirit of keen curiosity; see problems in the familiar; learn to detect the unusual; perceive the little things, the straws that show the way the wind blows; dig for the reality behind the appearances; let one question suggest another; be patient and persevering. In your reasoning be impartial, a most difficult matter, for it is almost impossible to approach any problem with the mind free from preconceived opinions and ideas. You will see (or rather persuade yourself that you see) nothing so easily as that which

you would like or expect to see, "the wish is father to the thought"; you will overlook most readily that which conflicts with your existing opinions. To correct as far as practicable this natural bias, learn to doubt; ponder closely upon what you see; question your first impressions. Seek for test checks to impose that will enable you to confirm your observations.

One useful system in fact-seeking is that which may be called the method of extent and intent, the look-it-over and think-it-over way. For example, when inspecting a machine, cast the eye carefully over the whole of the visible surfaces, when all such points as fastenings, clearances, and cleanliness will be brought under review; then start at the beginning of the operation for which the machine was designed, and consider the purpose for which each component was provided, asking yourself, for instance, what is it supposed to do? How is it intended to do it? Does it do it? Is it properly placed? Use all the senses with the mind always actively questioning: How? Why? Where? When? Be sure you cover the whole ground: if after any investigation you have to pay a second visit to obtain any fact available on the first occasion, seek carefully for the weak spot in your method of attack, and, having found it, strengthen it in future. Put the facts on record as soon as possible after they have been ascertained while they are fresh in the mind, and be particularly careful to record the unpalatable ones. If the making of the record is delayed, the actual facts may be masked as a result of the thought you have given to the matter in hand between taking the observations and putting them in writing.

Usually, after the facts have been investigated, they have to be reported on either verbally or in writing. A good report is correct, clear, and complete; so far as facts are concerned it should give to the reader the information he would have obtained had he made the investigation personally, and the conclusions arrived at from consideration of the facts should be clearly distinguished from the facts, so that the reader may form his own conclusions (which may or may not agree with those of the reporter) on reliable data. It is essential that no looseness of phraseology should be allowed to nullify the care taken in the collection of the information.

A word of warning as to the use of technical terms is perhaps permissible. The non-technical reader will, of course, not understand them, though, unfortunately, he may sometimes think he does, for such words as "saturated" have ordinary, as distinct from technical, meanings; but the technical reader may also be misled perhaps, for the same technical expression is frequently used in different branches of science with different meanings. "Bearing," for example, conveys one idea to the navigator, another to the man in the engine room; "valve" may cause confusion if the reader is a wireless man and the writer is dealing with questions of a power plant. Be sure, then, to say precisely what you mean, and do not strive after "style" which is apt to obscure the meaning: cultivate clearness, avoid ambiguity. Indicate the degree of accuracy attainable in any measurements you quote, and remember that details of what was not found may be most useful; as the military text-books put it: "negative information is of value."

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Meeting and Thompson Memorial Presentations.

At the annual general meeting of the Institution of Electrical Engineers, last week, a portrait of the late Dr. Silvanus P. Thompson was presented to the Institution, to be hung in the library; in handing it over Mrs. Thompson explained that it was painted during the year the doctor was elected a Fellow of the Royal Society, forty years ago.

Mr. W. M. Mordey next presented to the Institution, on behalf of the subscribers to the fund, Dr. Thompson's library, describing how it came to be acquired, and explaining the manner in which the committee of presidents of institutions and societies was formed to collect subscriptions for the purpose. The library had been purchased as a tribute to Dr. Thompson's memory by a number of members of the Institution and others who knew him and valued his work.

Mr. J. E. Raworth also presented the Institution, on behalf of the Finsbury Technical College Old Students' Association, with a rbonze bust of Dr. Thompson, by Mr. Gilbert Bayes, A.R.A., and in doing so pointed out that part of the funds collected for the bust had gone towards the purchase of the above-mentioned library.

Finally, Mr. F. Gill (president of the I.E.E.), formally accepted the gifts on behalf of the Institution and thanked all those who had made it possible for them to be presented and also for their choice of the I.E.E. rather than another institution to which to present them.

Prof. Elihu Thomson, hon. member of the I.E.E., who by a coincidence happens to be in this country, having crossed the Atlantic on an emergency call, expressed his pleasure at being afforded an opportunity of saying a few words in commendation of Dr. S. P. Thompson's character and work, and remarked, incidentally, that he had recently entered his 70th year, while that day was the anniversary of Col. R. E. B. Crompton's 78th birthday.

Annual Meeting.—In opening the annual meeting of the Institution the president announced the Council's recommendation that the subscriptions of Members and Associate Members be reduced by 10s. per annum and that of Graduates by 5s. That decision, he said, had been come to notwithstanding the fact that the arguments in favour of retaining them at their present level and thereby enabling the Institution to expand its activities were equally as strong as those in favour of a reduction.

Mr. F. W. Purse, who had been prepared to criticise the accounts in an endeavour to urge the reduction of the subscriptions, congratulated the Council on the step it had taken.

Mr. W. R. Cooper, the original proposer that the Council should consider a reduction of subscriptions when in a position to do so, also expressed his appreciation of the Council's action.

Dr. S. P. Smith pointed out that the rapid and healthy growth of the Institution was imposing upon it heavy responsibilities. It was a learned society, and one of its objects was to distribute knowledge amongst its members; therefore, although the *Journal* was the best of its kind that he knew of, the Papers Committee would no doubt like to increase its expenditure; further, he suggested that *Science Abstracts* should be offered to every member free of charge—those who did not want it should be asked to say so.

Mr. J. W. Meares inquired whether the reduction applied to foreign members, and was answered in the affirmative.

Mr. H. J. Cash considered that the Council's pledge to reduce the subscriptions when able to do so had been satisfied, and he hoped its action would not be looked upon as a precedent. There were many members who would rather pay 10s. per annum more than see the Institution lose over £3,000 per year and thereby, perhaps, be prevented from increasing its activities.

Mr. Ll. B. Atkinson thought it necessary to point out that no "pledge" of any sort had been given. Theirs was the only institution that had been able to increase its subscription rates without any trouble worth mentioning, and it was, moreover, the first to reduce its subscriptions to very nearly pre-war level.

Mr. F. Gill, president, in outlining the annual report, which was abstracted in our last issue, thanked Lieut.-Col. W. A. J. O'Meara for the hard work he was doing in connection with the War Memorial Book, and expressed his disappointment with the attendance at many of the ordinary meetings last session. All the Local Centres were very healthy, and the Institution owed much to its local officers. Mr. Gano Dunn, a past president of the American I.E.E., had been appointed local hon. sec. for the U.S.A., and Mr. M. L. Kristiansen, chief engineer of the Norwegian Government telephone service, had been appointed in a similar capacity for Norway.

The Council's report for the year 1922-23 was adopted unanimously.

Sir James Devonshire, honorary treasurer, then pointed out the salient points in the accounts, which were referred to in our last issue, and, after a few questions had been asked and answered, the accounts were unanimously adopted.

The auditors, Messrs. Allen Attfield & Co., were re-elected, and the usual votes of thanks to the officers of the Institution—both at home and abroad—were passed.

The President subsequently announced that the Council's premiums for papers submitted during the session had been awarded to the following gentlemen: Institution Premium to the late Dr. G. Kapp; Ayrton Premium to Mr. F. Creedy; Fahie Premium to Dr. H. W. Nichols; John Hopkinson Premium to Mr. J. Rosen; Kelvin Premium to Messrs. S. W. Melsom and E. Fawssett; Paris Premium to Mr. J. Caldwell; Webber Premium, no award.

Extra Premiums to Messrs. L. Breach and H. Midgley, F. T. Chapman, P. J. Robinson, and A. T. Dover.

Wireless Premiums to Messrs. E. B. Moullin and J. Hollingworth, Dr. N. W. McLachlan and Prof. C. L. Fortescue.

The Students' premium awards are to be announced at a later date.

The report of the Committee of Management of the Benevolent Fund, which was submitted to a meeting of subscribers before the annual meeting of the Institution, stated that the capital account stood on December 31st, 1922, at £9,970. The income for 1922 from dividends, interest, and annual subscriptions was £646, and in addition the Fund received from the Electrical Engineers' Ball Committee £58; from the Informal Meetings Committee, £25; from the Midland Electrical Engineers' Ball Committee, £20; and other donations, making a total of £401; as well as special donations in response to Sir E. M. Hughman's appeal, amounting to £1,768. The balance of the income and expenditure account amounted to £1,463. The capital account of the Wilde Fund stood at £2,798, which brings in an annual income of £100. No grant from this fund was made during the year.

The report and accounts were adopted unanimously; Mr. J. Attfield, F.C.A., the hon. auditor, was re-elected, and the names of the Committee of Management for 1923-24 were announced.

PARLIAMENTARY NOTES.

[By Our Special Parliamentary Reporter.]

London County Council (Money) Bill.—On May 31st the second reading of this Bill was moved in the House of Commons. During the debate, the London tramway system was severely criticised. Sir F. Banbury suggested that in order to relieve traffic congestion, the system should be "scrapped." Mr. Hume, replying for the London County Council, said that the tramways were still in an exceedingly flourishing condition, and were fully capable of taking care of themselves for some time yet. But the problem was arising of how far the tramways and the tubes would be able to withstand possible developments in the future. If an omnibus could come anywhere near the carrying capacity of the tramcar, the doom of the latter in our large cities would be sealed. There was not the slightest doubt that a fixed rail in a congested area was not a thing to be desired unless it was absolutely necessary. But owing to the refusal of local authorities and the difficulties of getting tramway schemes through the House of Commons, the Council were obliged to leave the tramway system in its present disjointed condition. They were asking for £150,000 to provide motors of greater power in order to "speed up" the system. They were also improving the coaling arrangements at the generating stations.

The Bill was read a second time.

Workmen's Compensation.—On May 30th the Government's Workmen's Compensation (No. 2) Bill was read a second time.

London Electric Railway Bill.—This Bill has been read the third time in the House of Commons.

Special Orders.—On May 28th, on the motion of Col. ASHLEY, the House approved the Special Electricity Orders made by the Electricity Commissioners in respect of the parishes of Radyr, Glamorgan; Welwyn Garden City and Kirkwall; and for the amendment of the Street and District Electric Lighting Order, 1915, and of the Teignmouth Electric Lighting Order, 1915. The Order made by the Electricity Commissioners, and confirmed by the Minister of Transport, constituting the South-East Lancashire Electricity District, and establishing the South-East Lancashire Electricity Advisory Board, was also approved.

Electricity in United States Mines.—In an article on "Electrical Industries and the Coal Supply," contributed to the *N.E.L.A. Bulletin*, Mr. J. W. Lieb states that electrical haulage is employed in 46 per cent. of the coal mines of the United States, while electrical coal-cutters are used in 51 per cent. Owing to the circumstance that few rivers of adequate size are available for condensing purposes in the coal regions, the establishment of pit-head power stations is not considered possible of attainment.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Costing.

In reply to the letter which you published in your issue of May 25th, from "Another Cost Accountant," may I be allowed to state that it is generally understood that the term "factory cost" is synonymous with the term "cost of production," and that both these terms cover the cost of manufacturing an article or product and of turning it into the warehouse.

F. C. Lawrence.

Manchester, *June 1st*, 1923.

Small Village Lighting Schemes.

With reference to Mr. Wood's letter in your issue dated June 1st, it is an error on the part of Messrs. Johnson and Phillips, Ltd., to state that Wark was the first village to be electrically lighted North of the Tyne, as this should read: "The first village to be electrically lighted on the River North Tyne."

F. Reid, Ferens & Co.

Newcastle-on-Tyne, *June 4th*, 1923.

The I.E.E. Council Nominations.

As usual, the list of Council's nominations for election to the Council of the I.E.E., just received, omits any representative of the electrical machinery manufacturers, who surely form one of the most important branches of the industry, and include many of our leading engineers. As far as I am aware, these interests are not represented on the Council at all, and for a long time past such representation has been conspicuous by its absence. Is not this very regrettable?

M.I.E.E.

June 5th, 1923.

Meter Readings and Multiplying Factors.

I am connected with two small town-lighting undertakings which commenced the electric supply at 110 volts d.c. Recently the voltage was increased to 220 volts, and to obtain the correct readings on the 110-volt house meters the actual units shown on the meters (which are of the Bastian electrolytic type) have to be multiplied by 2.

Several consumers are questioning the legality of this procedure, and I should be very much obliged for the views of your readers on the question.

Secretary.

June 5th, 1923.

Trade Organisation.

Mr. Beadle's letter in your issue of the 1st instant will be heartily endorsed by a considerable section of the much-maligned wholesalers, who feel that it is high time they became vocal.

The chaos existing in the electrical trade is generally admitted—the E.C.A. trade policy is a bold step towards removing at least some of the anomalies which exist. The manufacturers' and factors' view-points must not be forgotten, however, and there is no doubt that a round-table conference between the three chief sections of the electrical trade would have great potentialities for good.

Naturally, difficulties would arise, but with goodwill and a spirit of toleration, these should not prove unsurmountable. In any event, this correspondence should prove that some, at any rate, of the wholesalers are alive to the changing spirit of the times, and would welcome an opportunity of discussing the various points of difference with the manufacturers and the contractors.

Mr. Beadle's remarks regarding the short-circuiting of the contractor and the factor by several motor manufacturers will strike a sympathetic chord with many wholesalers, who have had only too bitter experience of the facts he mentions, and have been compelled, in self-defence, to import foreign motors.

For **T. B. Morley & Co., Ltd.**
A. B. CANNON, *Manager.*

Hull, *June 5th*, 1923.

I have read with great interest the correspondence in your columns on the subject of trade organisation, and I am speaking for my Association when I say that we are particularly gratified at the general approval expressed of the policy which we have formulated and propose to follow in trading matters.

Mr. T. Beadle, in your issue of the 1st instant, expresses the objects which the Electrical Contractors' Association has in view very admirably. He is quite right in his statement that there are contractors who can place large stock orders for motors. I know of such, and have seen several orders for 50 motors at a time ordered by a contractor for stock. As

your correspondent says, the whole question is one of terms and security that the manufacturer will not go behind the retailer's back. The moment there is even a suspicion of this, confidence is lost, and machines will not be ordered for stock but only purchased as and when required.

I have no doubt that the position between manufacturers and wholesalers is very much the same, and I can confirm from experience Mr. Beadle's remark that both wholesalers and contractors seek sole agencies from Continental firms because they then have security that the particular line of goods they sell cannot be offered to the user direct by the manufacturer.

Mr. Beadle complains that "in recent Press articles and letters there has been a tendency to look upon the wholesaler as an unnecessary part of the sales machinery." This is so if the word "recent" is emphasised. Until lately there was no objection taken to the position of the wholesaler, but during recent years his number has increased tenfold. He demands a super-discount without giving corresponding service, and he weakens the retail side of the trade which it is so important to strengthen, by canvassing the user direct. No one objects to the wholesaler who carries upon his shoulders the cost of distribution in small quantities and makes his purchases from the manufacturer in large bulk, but there is every possible objection to the man who collects and transmits the orders of the users to the manufacturers and demands more than the retailer's profit.

It will be observed that if the principle advocated by the Electrical Contractors' Association, of a combined trade and quantity discount, be adopted, the whole difficulty of the relationship between contractors, wholesalers and users is solved.

Your readers will no doubt be interested to know that owing to the large number of applications received for copies of the "E.C.A. Policy in Trading," this has now been reprinted in suitable form, and the Secretary, Mr. L. G. Tate, 15, Savoy Street, Strand, will be pleased to supply a copy to any interested applicant.

H. Marryat, M.I.E.E., M.I.Mech.E.,
President of the Electrical Contractors' Assoc. Incorp.

London, *June 4th*, 1923.

REVIEWS.

(1) *Standard Handbook for Electrical Engineers.* Edited by Frank F. Fowle. Fifth Edition. Pp. 2,137. New York: McGraw-Hill Book Co. Price 30s. net.

(2) *Handbook for Electrical Engineers.* Edited by Harold Pender. Second Edition, 1922. New York: John Wiley and Sons. Price 30s. net.

Because the subject of electrical engineering has now grown to such gigantic dimensions as to be beyond the compass of any one mortal mind there arises the necessity for electrical handbooks. To these the engineer whose activities range over one section of the electrical field, will turn for information on branches of the subject with which he has but occasional concern. Two such handbooks, both hailing from America, are before us for review. Their similarity in title, size, format and price is noteworthy, but they differ fundamentally in arrangement and method of treatment. Both books are well produced: paper, type, diagrams, and binding are in both cases all that could be desired; compendious indexes are provided, in one case extending to over 100, and in the other to as many as 66 pages.

(1) The "Standard Handbook," edited by Fowle, was first published in 1907, and is now in its fifth edition. Here the "unit" system has been adopted, the entire field of electrical engineering being divided into 25 sections, each section assigned to one or more specialists. Each of these sections is complete in itself, and some repetitions are purposely made to save the time of the user. The names of a few of the contributors will serve to indicate the authoritative nature of the various articles: Karapetoff (electric and magnetic circuits), H. M. Hobart (a.c. generators and motors), Alexander Gray (d.c. generators and motors), Chester Dawes (power transmission), Terrell Croft (interior wiring), Elmer Sperry (gyro-compasses).

A numbered thumb index is provided to these 25 sections, and each section is sub-divided into paragraphs, which are numbered consecutively through the section. A most valuable feature is the provision of detailed bibliographies to each subject treated, general reference books being given at the end of each section, while special references are given at the ends of paragraphs or as footnotes.

A great wealth of information, adequately classified and well illustrated, is comprised in every section. Two subjects upon which we should perhaps expect much from America, power plant and electric railways, occupy between them 350 pages, while a section on radio-communication has now been added to an already well-filled chapter on telegraphy and telephony.

(2) Pender's Handbook, now in its second edition, has been considerably enlarged since its first publication in 1914. Many of the articles have been entirely re-written, including those on electric heating and cooking, insulating materials and radio communication, the latter replacing the articles on detectors, electric waves, wave meters, wireless telegraphy and wireless telephony. New articles have been added on electric ignition, welding, electric propulsion of ships, and frequency changers.

This handbook has an alphabetical arrangement, and is consequently more in the nature of an electrical encyclopædia. Direct reference is perhaps facilitated by this arrangement, but the book loses somewhat of its value for consecutive study. Every article is complete in itself and is followed by a bibliography and references to periodical literature on the subject.

Great care has been taken to ensure that all the information given is strictly up-to-date, and a notable feature is the cost data given in connection with electrical machinery and installations. Most of the prices are quoted as in 1923, although here and there earlier figures have been utilised where later data were not available. This information concerning costs appears to be a particularly useful addition, as it is seldom that young engineers possess much first-hand or other accurate knowledge on this subject.

Both of these books are thoroughly good reference books. Neither of them would have enabled Robinson Crusoe to erect a modern electric power station on his island with the materials he salved from the wreck, but either will give the busy electrical engineer information about just that subject upon which he needs an epitomised account of up-to-date practice.

The Practical Testing of Dynamos and Motors. By Chas. F. Smith, D.Sc. Ninth Edition. Pp. 271; figs. 120. Manchester: The Scientific Publishing Co. Price 7s. 6d. net.

The fact that Dr. Smith's book on the testing of continuous-current dynamo machinery is now in its 9th edition is sufficient evidence of its usefulness, for it can be taken for granted that the students, test-bay assistants and others for whom the book is obviously written are not a class who are in the habit of buying books merely to adorn their bookshelves.

The present issue includes a number of additions and alterations resulting in three new chapters. Most of these additions represent the development of modern practice in continuous-current testing, and especially valuable is the series of experiments on the action of interpoles in producing sparkless commutation.

The earlier portion of the book deals with the laboratory type of testing, and will be useful chiefly to the engineering student who carries out tests in order to learn. The later chapters deal with tests of a more commercial type, including performance, efficiency and load tests, and also the testing of combined engine and dynamo sets. In every case a full description is given of the test, together with diagrams of connections and specimens of results and curves obtained.

Some very useful practical testing hints are given in a preliminary chapter, and these may be followed with advantage by every student in a laboratory and every test-room engineer.

Dr. Smith has contrived to include in his book practically all the usual commercial tests employed in works. The fact that while the well-known Hopkinson test figures in the index is not referred to as such, but merely as a back-to-back test in the text, appears to call for some comment, as does the lack of any mention of testing for dynamic balance, a very important but often neglected quality in electrical machines.

The book is clearly printed and well illustrated by line diagrams, and can be recommended as a very valuable laboratory or test-bed companion.

Steam Turbine Theory and Practice. By William J. Kearton, Assoc.M.Inst.N.A. Pp. xvi+456; 250 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 15s. net.

The appearance of another work on the steam turbine naturally inclines the student of engineering to seek its *raison d'être* when so many eminent specialists have already contributed to the literature of the subject. The author puts forward the plea that many of the recent works on the steam turbine have been over-developed along certain lines, and in consequence are not generally useful to the average engineering student. In order to remedy this deficiency he has produced this work, which is primarily intended as a text-book for engineering students, although, owing to the field covered, it should prove useful to engineers and draughtsmen seeking information on the theory of the steam turbine. A useful feature of the book is the large number of worked out examples and also the test questions with answers, which enable the keen student to gauge his progress to some extent by carefully working through them.

The calculus is used throughout the text, and the various symbols employed have been tabulated at the outset. No difficulties should arise in connection with the graphical methods adopted, which should appeal most strongly to the practical engineer whose mathematical knowledge is rather more limited than that of the engineering student.

In the opening chapter the principles and inherent characteristics of the steam turbine as a prime mover are briefly considered in comparison with the reciprocating steam engine. On p. 3 the author is not very clear with regard to the economic limit of expansion of the steam in the cylinder. After explaining that the economic limit imposed on the size of the cylinder is due to the very large specific volume of the steam at low pressures, he states that it is not usual to complete the expansion in a steam-engine cylinder, but to "release" the steam at a pressure a few pounds above the atmosphere. Surely the author means that the steam is usually released at a pressure of a few pounds absolute, as he previously states that most steam engines and turbines are provided with condensers.

The term "enthalpy" is used to denote the total energy of the steam instead of the more usual expression of "total heat," which the author considers is a rather misleading name, as the total energy is equal to the total heat H plus the heat equivalent of the work done in forcing the feed-water into the boiler against the steam pressure P, in pounds per square foot absolute.

The difference between the total heat and the enthalpy or total energy of a pound of steam is extremely small and may be neglected in practical calculations, but it is of importance in thermodynamics, and various terms have been suggested to distinguish total energy from total heat. Whether the term "enthalpy" will find universal favour or not is a matter of conjecture; such expressions as "holotherm" are already in limited use to denote the total energy of the substance, but possibly the most important point is with regard to the symbols used, and it is gratifying to find "I" employed to represent the total energy of steam.

The flow of steam through nozzles is naturally one of the most important subjects in any work on steam turbine theory, and the author has gone fully into the theories and methods employed in calculating the dimensions of nozzles. The methods employed in experimental work are touched upon, including Dr. Stodola's classical researches, whilst the more recent theories of supersaturation, as put forward by Wilson, Callendar, and Martin are briefly mentioned. No reference, however, appears to be made to the researches of the Steam Nozzles Research Committee of the Institution of Mechanical Engineers, which are being conducted at Manchester. The practical construction of nozzles is considered and some useful data are given, whilst the set of examples at the end of the section is particularly good.

In view of several most regrettable turbine failures recently in power stations in connection with medium-sized turbo-alternators operating at 3,000 r.p.m., it would appear that there is still a lack of knowledge as to the permissible working stresses for steel rings and disks subjected to high-temperature steam. Methods of calculating the strengths of rings and disks are given, but few data regarding the metallurgical aspect of the problem are included, although, of course, it is here that further research is required. The author's practical experience in design has enabled him to go fully into the various methods employed in the drawing office.

The history and development of the Parsons turbine, from its inception in 1884 to the present day, is briefly set out, and it is interesting to note that the 20,000-kW set which was supplied to Chicago over eight years ago probably possesses the highest Rankine cycle efficiency yet obtained for any machine of its size in the world.

An interesting chapter is given on the Ljungström radial-flow turbine, which has proved to be a most efficient type of machine for outputs up to about 5,000 kW.

The figure quoted for the efficiency ratio of the first Ljungström turbo-alternator of only 1,000 kW capacity is 77 per cent., but this should probably be 72 per cent., as the former figure was only just exceeded on the first or experimental 5,000-kW set which was installed in the same power house in London about three years later.

The application of turbines to marine propulsion is the subject of a most interesting chapter, in which the author traces briefly the development of the marine turbine from the historical trials of the *Turbinia*, in 1896, by the Parsons Co., to the present-day practice of large geared turbines running at comparatively high speeds. Some useful facts concerning speed-reduction gearing are given, and the section concludes with a brief description of some of the methods adopted for turbo-electric propulsion.

Finally, the trend of modern developments is considered in a chapter on recent advances in steam turbine engineering, in which the author shows that we have almost reached the practical limits of design and construction unless great improvements can be effected with regard to the metals used in construction.

The author's treatment of the subject is quite sound, and he is to be congratulated on having written a text-book which should be really useful alike to the engineering student and the practical engineer or draughtsman who is interested in the theory and design of steam turbines. The book is well illustrated, has a good index, and is most lucidly written, whilst it is remarkably free from errors, and its moderate price should bring it within the reach of the average student or engineer desirous of obtaining a good general knowledge of the subject.

L. M. J.

INDUSTRIAL LIGHTING AND THE PREVENTION OF ACCIDENTS.

A PAPER on the above subject was read by Mr. L. Gaster, before the ROYAL SOCIETY OF ARTS, on May 16th, the chair being taken by Sir Malcolm Delevingne, K.C.B., Assistant Under-Secretary for State, Home Office.

Mr. Gaster, in his opening remarks, recalled some of the advances in methods of lighting that had taken place during recent years, notably the introduction of electric gasfilled lamps, which had led to a more general use of overhead lighting and much higher values of illumination than were formerly customary. Another event of interest had been the development of systems of "artificial daylight," enabling colour-matching to be done by night as well as by day.

Turning to the question of accidents, Mr. Gaster pointed out the economic importance of reducing the considerable number reported each year, which in 1920 reached nearly 150,000 and involved a payment of over £6,000,000 in compensation—quite apart from minor "unreported" mishaps and accidents in mines and on railways. While he did not wish to create the impression that bad lighting was the only, or even the chief cause of accidents, it was nevertheless an extremely important item, both in relation to safety and as affecting the health and efficiency of workers.

The effect of inadequate lighting on the eye was well recognised, but another very important point was its influence in causing industrial fatigue, which in turn led to mistakes and accidents. Investigations by the National Institute of Industrial Psychology had shown how small modifications in methods of work had resulted in improvements in output of from 10 to 40 per cent.; in the case of sweet-packing, better lighting had been found to result in a 10 per cent. rise in output. In another experiment described in the *Journal* of the National Institute of Industrial Psychology it was found that by using a lamp giving four times the light of the ordinary miner's electric lamp, workers could produce 14 per cent. more coal; hence the use of a more powerful lamp fed by a bigger battery deserved consideration, even though it involved greater weight. Experiments conducted by the Commonwealth Edison Co., in Chicago, had shown a similar result—that by means of better lighting, increases in output of from 8 to 27 per cent. could be obtained. The avoidance of spoiled work was, however, often an even more important point than increased output, as it might prevent serious loss of prestige. It was general experience that poor lighting often led to costly mistakes and waste of material.

Mr. Gaster then proceeded to explain in detail the recommendations of the Home Office Departmental Committee on Lighting in Factories and Workshops, which have been noted from time to time in the ELECTRICAL REVIEW. He showed that the requirements as regards avoidance of glare could be quite easily complied with by means of modern lighting appliances, and that the values of working illumination now tentatively recommended (3 foot-candles for "fine work," and 3 foot-candles for "very fine" work) were often exceeded in up-to-date works where the management appreciated the benefits of good illumination. Thus in some printing works from 8 to 10 foot-candles was now provided on compositors' benches, and a committee which had been inquiring into the lighting of post offices in the United States had advised the use of illumination-values of this order, which, according to the methods suggested, would require about 2 watts per sq. ft. of surface illuminated.

The lecture was illustrated by a considerable number of lantern slides, some views of the repair shops of the London General Omnibus Co., showing the lighting conditions both by natural and artificial light, being of special interest. The arrangements for lighting the painting shop, comprising overhead gasfilled lamps in suitable reflectors, supplemented by special local lights to facilitate painting the upper decks of buses, and a row of lights beside the wall to illuminate the backs of vehicles, have received special study. In the engineering shop a feature is the local lighting, up to 25 foot-candles at places where the very accurate work of grinding shafts is undertaken.

In conclusion, Mr. Gaster recalled that there were now seven States in America which already possessed lighting codes, and that the subject was receiving attention from the Department of Industrial Hygiene, operating under the International Labour Bureau of the League of Nations at Geneva. He hoped that in the near future the recommendations of the Home Office Committee, which involved no hardship to workers or employers, but were designed for their benefit, would be embodied in the legislation of this country relating to factories; and that light, heat, and ventilation would be dealt with jointly as essentials to health, safety, and efficiency of work.

The chairman, Sir Malcolm Delevingne, after expressing his sympathy with the aims outlined in the paper, stated that the next Factory Act would contain suitable provisions for adequate lighting in factories, based on the recommendations of the Home Office Committee. The importance of good industrial lighting was now generally recognised, and what was chiefly needed was educational propaganda in order that the fundamental principles might be generally understood.

BUSINESS NOTES.

Bankruptcy Proceedings.—Richmond Rudd, Long Ashton, Somerset, electrical engineer.—The first meeting of the creditors of the above was held on May 30th at the Official Receiver's offices, 26, Baldwin Street Bristol. According to the statement of affairs, the gross liabilities amounted to £396, of which £261 was expected to rank, against net assets of £132, or a deficiency of £128. Debtor attributed his failure to want of capital, pressure by creditors, and costs in connection therewith. The case being a summary one, was left with the Official Receiver as trustee of the estate. The following are creditors:—

	£		£
Russell, J., & Co.	35	Sherwill, D. G.	11
Swan, E.	15	Simpson, Baker & Co.	36
Siemens Bros. & Co., Ltd. ...	25	Weeks, W. E., & Co.	79

J. Owen (J. Owen & Sons), electrical engineer, 186, Westcombe Hill, and 3, The Grove, Greenwich.—Trustee, Mr. T. Gourlay, Official Receiver, 29, Russell Square, W.C., released May 1st.

O. Greathead and W. Greathead (Greathead Bros.), electrical engineers and contractors, 50, Burnley Road, Bradford.—Composition of 6s. 6d. in the £, payable June 8th, at the Official Receiver's offices, 11, Winckley Square, Preston.

A. C. Ince, trading formerly as the Newcastle Electrical Engineering Co., now with a partner as the Tyne Electrical Industries, electrical contractor, 21, Fenkle Street, Newcastle-on-Tyne.—First and final dividend of 2s. 7¼d. in the £, payable June 11th at the Official Receiver's Office, 4, Northumberland Street, Newcastle-on-Tyne.

L. Holman, electrician, 11, Camden Road, Bridgwater.—Receiving order made May 31st on debtor's own petition.

W. P. Young (W. P. Young & Co.), mechanical and electrical engineer, 40, Sanvey Gate, Leicester, and (Leicester Tanning Machinery Co.) 42, Sanvey Gate, Leicester.—Receiving order made May 31st on debtor's own petition. First meeting, June 12th, at the Official Receiver's Office, 1, Berridge Street, Leicester; public examination, July 6th, at the Castle, Leicester. At a meeting of creditors held on May 31st, a statement of affairs was presented, and, with one dissentient, the meeting decided to request the debtor to file his petition in bankruptcy.

British Radiophone Co., makers of wireless apparatus, Downing Street, Bulwell, Nottingham.—Receiving order made May 30th on creditors' petition.

H. H. L. Symonds, electrical engineer (since deceased), late of 1, Downs Road, Wimbledon.—Last day for proofs for dividend, June 20th. Trustee, Mr. T. Gourlay, 29, Russell Square, W.C.

C. J. Haxby and E. Brady (Haxby & Brady), electrical engineers, 1a, East Parade, Harrogate.—First and final dividend of 8s. 4d. in the £, payable at the Official Receiver's Office, Duncomble Place, York.

Company Liquidations.—Radio Installations, Ltd., Empire House, 175, Piccadilly, W.—Pursuant to Section 188 of the Companies (Consolidation) Act, 1908, a meeting of the creditors in this matter was held on May 28th at the offices of Mr. G. W. Askew, accountant, 14, St. Mary Axe, E.C., when it was reported that the liabilities amounted to £809, while the assets were expected to produce £511. It was reported that the company was registered on September 12th, 1922, with a nominal capital of £1,000, divided into 700 shares of £1 each and 6,000 of 1s. each. The books of the company had been properly kept, and since the inception of the company up to the date of liquidation there had been sustained a loss of £249. Mr. Askew stated that he had had notification from Marconi House that royalties were due from the company, but he could not say how much was claimed. The sales had been £1,797 and the purchases £1,457, while £40 had been spent on advertising. It was said that the landlords were in possession of the premises for rents due, and furniture valued at £170 in the company's books had been seized by the landlords. After the matter had been discussed, it was decided to leave it in the hands of Mr. Askew as liquidator. The following are creditors:—

	£		£
Surrey Scientific Co., Ltd. ...	464	Allen, C.	28
Edison Swan Electric Co. ...	152	Mill & Russell	16
Leslie	44	Hunt, A. H.	11
D.P. Battery Co.	30	General Electric Co.	16
Ashurst, Morris, Crisp & Co. ...	30		

J. B. Midgley, Ltd., electrical engineers, &c., 26, Caledonian Road, N.—Pursuant to Section 188 of the Companies (Consolidation) Act, 1908, a meeting of the creditors in this matter was held on May 24th at the offices of Mr. A. A. Hall (Messrs. Hall, Baxter & Co.), accountant, 69, Broad Street Avenue, E.C., when a statement of affairs presented showed liabilities £627, while the assets totalled £331, or a deficiency of £296. The assets consisted of sundry debtors, £239, cash at bank, £52, and stock estimated to produce £40. It was reported that the company was incorporated on February 22nd, 1921, to take over the business of J. B. Midgley & Co. The capital was £500 in £1 shares. The directors were Mr. J. B. Midgley, Mr. J. J. Tanner Mr. F. Johnson, and Mr. P. E. Gallagher. It was stated that most of the company's business was done at Worcester Park, where it had a store. Mr. Houstoun, of Messrs. Corfield & Cripwell, asked what had happened to the stock that was at Worcester Park, and the liquidator replied that it had been removed from there and taken to 26, Caledonian Road. The company never had any stock at Caledonian Road before the liquidation. The premises were taken at a weekly tenancy of £1 a week. The drawings of the directors had been in the neighbourhood of £3 to £3 10s. a week each. The matter was fully discussed, and the opinion was expressed that some further investigation should be made. Mr. Hall intimated that he was quite willing to resign his position as liquidator, and eventually a resolution was passed appointing Mr. William Osborne, of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C., as sole liquidator in the place of Mr. Hall. The following are creditors:—

	£		£
Edison Swan Electric Co. ...	40	General Electric Co., Ltd. ...	177
Watsham's	92	Henley's Telegraph Works Co.,	
Markes Ward	101	Ltd.	25
General Cable Co.	19	Siemens & English Electric	
Ewall Garage	12	Lamp Co.	18
Metropolitan-Vickers Electrical		Whitworth	12
Co., Ltd.	64		

Direct United States Cable Co., Ltd.—Winding up voluntarily. Liquidator, Mr. W. Miles, 240, Winchester House, Old Broad Street, E.C. Meeting of creditors at Winchester House, June 14th (all creditors have been or will be paid in full).

Cark and District Electric Supply Co., Ltd.—Winding up voluntarily. Liquidator, Mr. A. E. Stringer, 31, Manor Row, Bradford.

Ventitheta, Ltd.—Winding-up order made by the High Court on May 29th.

Leitner Electrical Co., Ltd.—Third and final dividend of 1¾d. in the £, payable June 11th at Carey Street, W.C.

Crystophone Manufacturing Co., Ltd.—Winding up voluntarily. Joint liquidators, Mr. E. H. Hawkins, 4, Charterhouse Square, E.C., and Mr. A. A. Yeatman, 2, Coleman Street, E.C. Meeting of creditors at 4, Charterhouse Square, E.C., June 14th. Particulars of claims to the joint liquidators by July 31st.

Private Arrangement.—George Palmer (Universal Cinema Supplies), Ltd., 47, Gerrard Street, W., wireless dealers and kinema suppliers.—The creditors interested herein were called together on May 29th at the offices of Messrs. Purchase and Clarke, solicitors, 55-56, Pall Mall, S.W., when a statement of affairs presented disclosed liabilities of £2,865, made up as follows:—Rates and rent, £53; gas and electric light, £3; and unsecured creditors, £2,809. There was also a debenture for £500, with interest 17s. 10d. in favour of a Mr. Sharpe, who had appointed a receiver to act for him. The assets totalled £3,310, from which had to be deducted £501 for debentures, leaving net assets £2,809, or a deficiency of £56.

It was stated that the company was formed in 1915 with a capital of £6,000 in £1 shares, half of which was subscribed for. In August, 1913, Mr. Palmer, who was present, stated that he started business on his own account, but the war broke out, his premises were broken into by burglars, and a fire had taken place. Three years after that, he had formed the company, which consisted of himself and his wife.

Mr. Houstoun, of Messrs. Corfield & Cripwell, asked what had become of the money which Mr. Palmer had received on account of the debenture, and Mr. Palmer replied that it was paid out to creditors generally.

Mr. Palmer went on to say that he had been taking about £4 to £5 a week out of the business, and he employed a son at a salary of £3 10s. a week. The turnover had been about £300 a week.

Asked if money had been lost in the wireless section of the business, Mr. Palmer said that money had been lost both in the wireless and in the kinematograph sections.

After the matter had been discussed, it was stated that a friend of the debtor was willing to put fresh working capital into the business, and Mr. Palmer hoped in time to be able to pay a composition of 20s. in the £. Eventually a committee of inspection, consisting of Messrs. Trelleborgs, Mr. E. Judd, representing Siemens Electric Co., Messrs. Liddon, Mr. Houstoun, representing the General Electric Co., and the Williamson Film Co., were appointed to investigate the affairs of the company and report to a further meeting. The following are creditors:—

	£		£
Trelleborgs	177	Punch Ticket Co.	76
Browne, Ltd.	34	Pathé Frères, Ltd.	39
British-American Export Co. ...	23	Broad, T. H.	30
Baer, M.	17	Sloan Electrical Co.	25
Buck Bros. & Harding	66	Turner, E. G.	143
B.D.S. Wireless Co.	168	Waters Bros.	58
Champion & Co., Ltd.	57	Leach & Co.	23
Dubilier Condenser Co.	15	Lucas Engraving Co.	29
Electrical Manufacturing Co. ...	68	Metropolitan-Vickers Electrical	
General Electric Co.	70	Co., Ltd.	62
Fry, E. B.	21	Kent Bros. Electrical Co.	62
Wakelins, Ltd.	206	Electrical Engineering	24
Illingworth & Co., Ltd.	22	Bligh, S. W.	189
Liddon	116	Lawrence & Co.	36
Jones & Co.	12	Purchase & Clark	81
Mansell & Hogan	30	Odham's Press	16
Palmer, George	178	Langrish & Co.	14

Trade Announcements.—Messrs. Burton, Griffiths & Co., Ltd., 64-70, Vauxhall Bridge Road, S.W.1, have been appointed sole agents in the United Kingdom for the American Bosch Magneto Corporation, of Springfield, Mass., U.S.A., manufacturers of the Bosch ignition systems for motor vehicles.

Mr. George W. Richards, of Cardiff, who has been for many years outside representative for Messrs. Shenton & Co., Ltd., has now been appointed in a similar capacity by Engineering Supplies, Ltd., of Upper Thames Street, E.C.4.

Mr. Rob Auchterlonie has acquired the business of the Border Electrical Engineering Co., electrical engineers, Galapark Road, Galashiels (lately under his management).

Mr. George Hartigan, who has left the Triumph Electrical Manufacturing Co., Ltd., of Birmingham and London, has started the London Fan and Motor Co., in partnership with Mr. C. H. Roberts and Mr. D. Barrie, at 11, Grape Street, London, W.C.2.

Catalogues and Lists.—The Hotpoint Electric Appliance Co., Ltd., 21, Berners Street, W.1.—"The Home of a Hundred Comforts," a booklet containing illustrated descriptions of "Hotpoint" irons, grills, kettles, toasters, fires, and other appliances.

Messrs. Smart & Brown, Erith, Kent.—A reprint describing the "Simplicity" paraffin-electric generating set, together with postcards illustrating this.

British Insulated & Helsby Cables, Ltd., Prescot, Lancs.—Pamphlet P. 178, containing numerous illustrations and descriptions of "Prescot" armoured cables, joint boxes, racks, reactances, feeder pillars, and other accessories.

The Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N.17.—Leaflet No. 627, illustrating and describing "Bencolite" lighting fittings. Priced.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester.—An artistic folder illustrating the "Cosmos" electric iron, and arranged for overprinting. Priced.

Messrs. Edmiston, Brown & Co., Ltd., 219, St. Vincent Street, Glasgow.—An illustrated brochure describing electrically-driven haulage gear, mining type distribution boards, and cable joint boxes.

The London Factors and Agents, Ltd, 38 and 39, Parliament Street, S.W.1.—June price list of electrical materials and accessories, including accumulators, bells, cables, conduits, lampholders, fans, &c.

Autoveyors, Ltd., 84, Victoria Street, S.W.1.—A priced catalogue of radio apparatus, with a view of the firm's demonstrating theatre, which is the original captain's cabin of H.M.S. *Impregnable*—last of the "wooden walls of England."

Brookhirst Switchgear, Ltd., Northgate Works, Chester.—Calendar cards for June-September, bearing illustrations and notes of the firm's products.

Messrs. P. Nuttier & Son, 41, Side, Newcastle-on-Tyne.—A table of fuse wires for currents ranging from 656 to .55 A.

Messrs. Ferguson, Pailin, Ltd., Higher Openshaw, Manchester.—A series of illustrated pamphlets describing in detail various types of industrial and mining switchgear, oil-immersed, armour-clad, and truck patterns. Also an illustrated booklet describing operating gear for oil-immersed circuit breakers, switchboard mounting.

The Medical Engineering Co., 71a, Englefield Road, N.1.—A price list of fractional h.p. d.c. motors.

The Midland Electric Manufacturing Co., Ltd., Barford Street, Birmingham.—A booklet setting forth the firm's manufacturing and selling policy.

The National Boiler and General Insurance Co., Ltd., National Buildings, St. Mary's Parsonage, Manchester.—An illustrated booklet and a pamphlet dealing with "National" fusible plugs.

Messrs. Bruce Peebles & Co., Ltd., Edinburgh.—An illustrated brochure dealing in some detail with "Peebles" motor-converters. This describes principles and construction and forms an interesting treatise on the subject.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2.—June price list of electrical supplies, including portable electric tools, wiring materials, switches and fuses, radio apparatus, motors, &c.

Siemens & English Electric Lamp Co., Ltd., 38-39, Upper Thames Street, E.C.4.—June price list of lamps, lighting fittings, fuses, fires, radio apparatus, &c.

Mr. David J. Patton, 43, Johnson Street, Westminster, S.W.1.—A price list of electrical materials, as tapes, compound, wires, ebonite, &c.

Dinner to Directors.—Last Friday evening the directors of Vickers, Ltd., were entertained at dinner at the Holborn Restaurant by the head office staff. The chief commissionaire at Vickers House presided, and proposed the toast, "Our Guests—the Directors." Mr. Douglas Vickers, the chairman of the board, in responding, said that the invitation came as a great surprise to them, and was highly appreciated. He described the occasion as unique in the industrial world.

Unemployment.—The Ministry of Labour unemployment returns for May 21st showed an increase in the number of persons wholly unemployed of 38,780, making a total of 1,207,300. It was stated that the increase was due to a temporary fall in textile trade activity, there being a reduction in non-textile districts. "Short-time" workers numbered 52,200, a decrease of about 1,500 during the week.

Foreign Exhibition.—Luxemburg.—The eleventh International Commercial Fair which the city of Luxemburg is holding from August 12th to 22nd has a special interest to electrical manufacturers by reason of the fact that the Chamber of Deputies is now considering a Bill for the electrification of the railways of the Grand Duchy, which will probably be passed before the time for the holding of the fair. Applications for space should be addressed to 19, Rue des Bains, Luxemburg.

New Showrooms. — Messrs. Galsworthy, Ltd., have arranged new showrooms on the ground floor and in the basement of their premises at 16, Newman Street, W.1. Here they are exhibiting a wide selection of lighting fittings in designs to harmonise with a multiplicity of architectural and decorative schemes. For the most part the fittings are of artistic metalwork, which is the firm's *forte*, but there is also an excellent display of alabaster and glassware.

Trade with Denmark.—The Commercial Secretary at Copenhagen, Mr. R. M. A. Turner, will be in attendance at the Department of Overseas Trade from June 25th to 30th, inclusive, and will be pleased to interview, by appointment, United Kingdom manufacturers and merchants interested in export trade to Denmark. Letters should be addressed, without delay, to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference 7,505 F. R.)

Ljungstrom Air Preheaters.—Messrs. James Howden and Co., Ltd., of Glasgow, after having made extensive trials at their works of the new Ljungstrom air preheater, have acquired a licence for land boilers for this country, and can furnish complete tenders and proposals for the application of the preheater to all types of this class of boiler. They also hold the exclusive world licence for its application to marine boilers.

The Boilermakers' Lock-out.—The conference requested by the Boilermakers' Society between that body and the Shipbuilding Employers' Federation was held on May 30th, but the employers declined to exercise any preference with regard to the general agreement towards the boilermakers, and the conference proved abortive and was therefore adjourned indefinitely.

Electricity Supply Rifle League.—A very successful prize meeting was held by the League on May 26th, on the ranges of the Hackney Club at Clapton. This was the fifth occasion on which members of the various clubs composing the League had met in this way, and on each occasion the weather has been ideal for outdoor shooting.

The following are the results of recent matches:—

County Co. 578, City Co. 575; Central A 587, West Ham 521; Central A 576, Shoreditch 574; Central B 560, West Ham 511; Shoreditch 577, Central B 536; County Co. 574, St. James' 565; Hackney 534, Central B 527; St. James' 561, West Ham 538; St. James' 567, Hackney 540; Central A 572, Central B 541; Shoreditch 574, Hackney 522; City Co. 581, Central B 551; City Co. 587, Central A 577.

The County Co. heads the League with 10 points.

Italian Electrical Industry.—The trend of the electric industry in Italy in 1922 is thus summarised by a contemporary:—"The year 1922 for electrical undertakings, regarded from the financial side, cannot be said to have been a bad one. Apart from the difficulties experienced in the early months by the undertakings in the north, the development of business of the remainder was good, and the increase of consumption had its beneficial results. On December 31st the position of the concerns may be said to have improved in the matter of dividends and in the cautious increase of capital. While on December 31st, 1919, there was only a single company with a capital above 100 million lire and four with a capital above 50 millions, to-day there are six companies with 100 and more millions and eight with capital above 50 millions. Comparing this with past years, it is seen that the aggregate capital of the principal companies rose from 1,500 millions in round figures on December 31st, 1919, to 1,700 millions on December 31st, 1920, and from 1,850 millions in 1921 to 2,100 millions (about) this year (to be exact, 2,094). The bonded debt of electrical undertakings has remained almost stationary at a little over 120 millions. The movements of the principal securities show a certain improvement in the quotations which corresponds with the slight improvement in the dividends. The index, which all through 1921 remained at about 100, with a lowest of 98 and a highest of 105.70, in 1922 gradually rose from 99 in January to 117.33 in December."—*Revista delle Industrie Elettro Ferroviaria, &c.*

New Italian Company.—There has been formed in Santo Stefano d'Areto the Società Idraulica e Idroelettrica Maggiorasca, with a capital of 350,000 lire.

Installation Contracts.—Messrs. Mann, Egerton & Co., Ltd., report having recently received the following, amongst other contracts for electric lighting, power, &c.:—Admiralty; Horse Guards; Home Office; Postmaster-General's office; Treasury; Gwydyr House; Colonial Office; Whitehall Gardens; Scottish Office; Customs Office; also for the Zoological Gardens, London; Lowestoft Hospital; Regent Theatre, Norwich; several large blocks of shops and offices in Regent Street and Haymarket, London; and many country-house installations.

Electrical Fittings for Argentina.—The most important building contract now being carried out in Buenos Ayres is a scheme by the Municipal Council, which proposes to construct 10,000 dwellings at the rate of 1,000 per annum. In addition many new private dwellings are either being constructed or are in contemplation. The majority of these houses are to be wired for electricity.

The Chabas Town Council (address: Senor Don Secretario, Municipalidad de Chabas, Rosario de Santa Fé) is inviting tenders for the supply of electric lighting fittings, &c. The firm of Avellaneda & Teram, owners of the sugar mill known as Ingénio "Los Ralos," Tucumán, is completing a new electrical installation to deal with the year's sugar harvest.

Three large Tucumán firms—Gath and Chaves, Ltd., J. Voss, and La Casa del Acqua—are about to put in hand a considerable amount of building. All these premises will be fitted with electrical appliances.

It is most important that British firms should be directly represented in Argentina, especially as the present is a particularly favourable time for arranging contracts of all descriptions in connection with house-building in Buenos Ayres.—*Reuter's Trade Service.*

E.D.A. Activities.—An illustrated pamphlet (E.D.A. 357), bearing the title "In Kitchen Cool," has been published by the Electrical Development Association. This extols the benefits of electricity for cooking, emphasising the fact that "electricity cooks without cooking the cook."

Storage Battery Manufacturers and Fair Trading.—Attention may be drawn to an announcement appearing among our advertisements to-day to the effect that the members of the Accumulator Makers' Association (Chloride, D.P., Hart, Premier, Pritchett & Gold and E.P.S., and Tudor Companies) have signed the Electrical Contractors' Association Fair Trading Clauses. Emphasis is laid on the fact that loyalty to the clauses on the part of manufacturers demands corresponding loyalty from contractors.

British Industries Fair, 1924.—*The Times Trade and Engineering Supplement* states that there is reason to anticipate that the 1924 Fair will be held at London and Birmingham in May, to enable visitors who have been attracted to this country by the British Empire Exhibition to attend the Fair as well.

Publicity at Manchester.—The Manchester Electricity Department has issued an illustrated booklet dealing with the various domestic applications of electricity. Its chief value lies in the fact that estimates of cost, based on the existing charges, are given, as well as details of the cooker-hiring scheme of the Department.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, June 5th:—Electrolytic copper bars, £74, 10s. decrease; ditto ditto sheets, no change; ditto ditto wire rods, £84, 10s. decrease; ditto ditto h.c. wire, 10 7/16d., 1/16d. decrease.

Messrs James & Shakespeare report, June 5th:—No change in prices for copper bar, sheet and rods. English pig lead, no change.

Applications for British Trade Marks.—The following are included among the recent applications for British trade marks. Objections may be lodged within one month from the dates mentioned. In the case of foreign applications, the names and addresses of the British representatives are also given:—

Abcar. No. 434,673. Class 6. Electrical vacuum cleaners.—Charles Bingham, trading as Chas. Bingham & Co., 34, Victoria Street, Westminster, S.W.1. May 30th, 1923.

Le Carbone A.D.C. (lettering and design). No. 426,445. Electric batteries in Class 8.—La Société Le Carbone, 12 and 13, Rue de Lorraine, Levallois-Perret (Seine), France. (D. Young & Co., 11-22, Southampton Buildings, Chancery Lane, London, W.C.) May 30th, 1923.

Abbiphone. No. 434,651. Class 8. Wireless telephonic apparatus.—Abbey Industries, Ltd., 81, Harrow Manorway, Abbey Wood, London, S.E.2. May 30th, 1923.

A B (lettering and design). No. 434,652. Class 8. Wireless telephonic apparatus.—Abbey Industries, Ltd., 81, Harrow Manorway, Abbey Wood, London, S.E.2. May 30th, 1923.

Mozzullphone. No. 435,529. Class 8. Electrical apparatus for use in wireless telephony and telegraphy.—The B. D. S. Wireless Co., 124, Devonshire Street, Birmingham. May 30th, 1923.

Volumite. No. 435,536. Class 8. Crystal detectors for wireless telephonic and telegraphic apparatus.—Autoveyors, Ltd., 84, Victoria Street, Westminster, S.W.1. May 30th, 1923.

Exide B. K. Shilling-a-Volt (lettering and design). No. 435,809. Class 8. Electric accumulators and parts thereof.—The Chloride Electric Storage Co., Ltd., Clifton Junction, Manchester. May 30th, 1923.

Chantecler. No. 435,002. Class 8. Apparatus for use in wireless telegraphy and telephony.—Gordon A. Litchfield, trading as the Nottingham Radio Supplies, 33, Mansfield Road, Nottingham. May 30th, 1923.

Cymosite. No. 435,276. Class 8. Appliances used as detectors in wireless communication.—Norman Hall, trading as the North-Eastern Electrical Instrument Co., Albert House, Durham Road, Low Fell, Gateshead. May 30th, 1923.

Etherite. No. 435,491. Class 8.—Apparatus for wireless telephony or telegraphy.—Louis G. Freedman, 10, Great Newport Street, Leicester Square, London, W.C. May 30th, 1923.

Vivavox. No. 435,845. Class 8. Telephonic apparatus.—Edward A. Graham, trading as Alfred Graham & Co., St. Andrew's Works, Crofton Park Road, London, S.E.4. May 30th, 1923.

Radiola. No. 436,408. All goods in Class 8, except gramophones, parts and fittings.—John R. Eccles, 10, Aston Street, Birmingham. May 30th, 1923.

Centra. No. 427,708. Class 14. Bulbs, globes, reflectors, &c., of glass and used in connection with electric lighting.—Osram Gesellschaft, 11-14, Ehrenbergstrasse, Berlin, O.17. Germany (Marks & Clerk, 57-58, Lincoln's Inn Fields, London, W.C.). May 30th, 1923.

Rex. No. 435,462. Class 18. Electrically-heated appliances and apparatus.—The Bastian Meter Co., Ltd., Bartholomew Works, Kentish Town, London, N.W.5. May 30th, 1923.

Arcovite. No. 435,542. Class 50. Electric insulating materials and electric insulators.—The Siluminite Insulator Co., Ltd., 16, Dowgate Hill, London, E.C. May 30th, 1923.

Latin-American Electrical Notes.—The new 2,000-h.p. generating plant, purchased by the Bogata Tramway Company, has now been erected and put into service. Owing to the rapid extension of different branches of the company's lines, it is expected that within a short period the plant will be supplemented, accommodation having been allowed for this addition when necessary.

There is a market in Cuba for self-contained generating sets capable of being operated with alcohol. In order to encourage the importation of such apparatus, a prominent group of distillers has agreed to manufacture sufficient quantities of alcohol for lighting purposes. It is thought that a large proportion of the *haciendas*, the owners of which are now better supplied with cash than at any time during the past two years, will be willing to introduce self-contained lighting sets as a means of economy. Up till now this has not been possible owing to the retail price of gasolene being about twice that of alcohol. The latter fuel is suitable where electric current and gasolene are unobtainable.

A group of Habana capitalists has recently formed a small company for the purpose of erecting electric signs in prominent places in the city and along the water-front. The signs will be used entirely for advertising purposes, and a favourable opening exists for novel automatic designs.

A new plant of 4,000 h.p. to supply electric light and power to the villages and towns in the Valle de los Chillos (Ecuador) has been installed.

In Guatemala there will shortly be required an electric lighting plant for the town of Jutiapa. At present it is intended only to install a dynamo for 1,000 lights as an experiment, but it is thought that additions will be necessary before the end of the present year.

In Nicaragua the Municipality of Boaco has entered into a 20-year contract for the construction and maintenance of an electric light plant. The town of Boaco is situated in the Department of Jerez, and has a population of about 4,000. Owing to the fact that the town is situated 35 miles from any other centre of industry (Juigalpa being the nearest), and over 105 miles from the nearest railway station, at Sacoana Grande, there is little scope for the extension of this enterprise.

A small electric lighting plant has been introduced in the city of Esparta, in the Republic of Costa Rica.

The city council of Guayaquil (Republic of Ecuador) is about to install an electrical plant in order to replace the gas lighting hitherto in use.

The city of Rosario, in the Department of Colonia, Republic of Uruguay, has recently completed an electric light and power plant and put it into operation.—*Reuter's Trade Service.*

Tube Works Strike.—On June 1st, several hundred men engaged in the reconstruction of the City and South London Railway ceased work as a protest against a reduction of wages. Passenger traffic on other parts of the line was unaffected. The employers offered to allow them to resume work at a rate 1d. per hour less, but at a meeting held on June 4th this was rejected. The men's unions disclaim any responsibility for the stoppage.

Book Notices.—The Faraday House *Journal*, Summer Term, 1923. London: Faraday House.—In addition to numerous notes of interest to past and present members of the Institution, this issue contains illustrated articles on "Producing Intermittent Currents by Means of a Neon Tube," by S. O. Pearson, B.Sc.; "The 'Robey' Oil Engine," by O. D. Claudius; &c. A full list of examination results is also given.

"From Factory to Face," by W. T. Anderson, M.I.E.E. (16 pp.). Manchester: W. T. Glover & Co., Ltd.—This is a reprint from the *Mining Electrical Engineer*, giving the history of a colliery cable from its manufacture to its installation and use.

"Practical Wireless Sets for All," by P. W. Harris. Pp. 78, illustrated. London: Wireless Press. Price 1s. 6d.

Water Softening.—Messrs. Lyons's New Corner House in Coventry Street, Piccadilly Circus, has been equipped throughout with the "Permutit" system of water softening by United Water Softeners, Ltd., of Kingsway. The same system is in use in Royal palaces, clubs, and large town and country mansions.

Annual Outing.—The first annual excursion of the employés of Messrs. Holt, electrical engineers, of Chester Street, Bradford, took place on May 26th, the party journeying to Bridlington by motor charabanc.

Columbian Electrical Plant.—A contract has been signed between the Municipal Council of Cartagena (Colombia) and a United States firm of engineers calling for the survey of the environs of the city in connection with water supply. In connection with the same contract, progress is being made with the installation of the first electric light and power plant, to be followed at a later date by a second installation.—*Reuter's Trade Service.*

Lead.—Messrs. James Forster & Co. report:—"The shipment of lead to Russia is, of course, a new development, and, if continued, may materially affect the position here. So far, we understand about 3,000 tons have been sold, part of which has already been shipped. Business with consumers, on the other hand, is very dull, and but for the Russian demand it is difficult to see how prices would have been maintained at the present level."

A Chilean Concession: A British Opportunity.—The Department of Overseas Trade is informed that a concession was recently granted for the construction of an electric railway from Santiago to some of its south-western suburbs. The concessionaire is a qualified engineer, who informed Mr. Bateman, who was until recently His Majesty's Chargé d'Affaires at Santiago, that he would be willing either to undertake the construction of the line in connection with a British firm or to sell the concession to a constructor who would undertake the whole business. The name of the concessionaire and full particulars of the scheme supplied by him can be obtained by British firms interested in the matter on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

Poland's Gradual Progress.—From a perusal of the Commercial Secretary's report on Poland, which has recently been issued by the Department of Overseas Trade (D.O.T. or H.M. Stationery Office, price 1s. 6d.), it is evident that the hopeful factor in the future of the country's commerce is the favourable trade balance that has recently been noticeable. There are, however, not a few unsatisfactory features. Owing apparently to political developments, the projected policy of financial economy was not rigidly applied during the latter half of last year, and resort to inflation has resulted. The country has suffered severely from the consequent rising tide of prices, which the report ascribes partly to profiteering. On the other hand, there is evidence that Poland is in a position to support higher taxation without suffering economically.

The outstanding event of the year was the incorporation of Polish Upper Silesia with its rich mineral wealth and highly developed resources, particularly iron and steel. With regard to the maintenance of the latter, the Commercial Secretary points out that this depends on the possibility of obtaining sufficient quantities of high grade ore from Sweden, as the importation from Soviet Russia is for the time being ruled out and as the quality of the Polish and Upper Silesian ore is inferior. The prosperity of these industries will also be conditional on the possibility of maintaining the German and capturing the Eastern markets for the sale of the products of those industries. It is remarked that whilst the French are showing considerable interest in Polish Upper Silesia, British capital has so far been invested only in one industrial undertaking. Polish industries generally were prosperous, with the exception of the petroleum industry, coal and cottons being especially active. Agricultural output was sufficiently large to leave a fair margin for export. The Commercial Secretary also states that the exploitation of railways, posts and telegraphs made further satisfactory progress. Much, however, remains to be done.

For Sale.—Torquay Corporation Electricity Department has for disposal one induced-draught plant and steel chimney. Belfast City Tramways Department invites offers for about 1,000 tons of old rails, points, &c., also about 12,000 tons of old setts. Messrs. Waring, Son & Daw will sell by auction on June 18th and 19th, at 5 and 7, Brook Street, New Bond Street, W., electric light fittings, furniture, &c. Lancaster Corporation has for disposal three Belliss-Westinghouse generating sets. South Shields Board of Guardians invite offers for surplus generating plant at the Barton Institution. (See our advertisement pages to-day.)

LIGHTING AND POWER NOTES.

Abertillery.—Electricity Charges.—The Urban District Council has applied to the Electricity Commissioners for sanction to maintain the maximum charge of 9d. per kWh for electricity after the expiration of the Order on August 31st. It is also proposed that application be made for an Order, authorising the Council to supply electricity to the outskirts of the town.

Accrington.—Year's Working.—The report on the working of the electricity undertaking for the past year shows a total revenue of £81,377, as compared with £80,225 in the previous year. Working expenses amounted to £35,345, a decrease of £10,000. After providing for interest, capital charges, &c., there was a net profit of £23,124, of which £2,565 has been appropriated for the purchase of meters, motors, &c. The number of kWh sold increased from 7,946,852 to 9,773,591.

Australia.—Morwell Electricity Scheme.—It is anticipated by Sir John Monash, chairman of the Electricity Commission, that the first electric generators will be ready for commercial operation in the early part of next year. The dry weather has enabled the Commissioners to complete practically all the subterranean work at Yallourn, and the works on the weir are now out of danger, even if heavy floods occur. The circulating-water conduits and the framework of the power house have been completed, and two of the five turbo-generators have been partially erected. Good progress is also being made with the coal mining. The distribution of the overburden is well advanced, and an area 600 ft. wide and 700 ft. long has been stripped, revealing a deposit of coal fully 175 ft. thick. The main transmission lines from Yallourn to Yarraville are progressing well, over 350 steel towers, equipped with insulators, having been erected.—*Industrial Australian and Mining Standard.*

Loans for Electrical Development.—Among the latest proposals for electrical development are the following:—Approval is sought to the borrowing of £100,000 for the development of the power of the Nymboida River to the extent of 1,200 kW under a head of 200 ft., with 33,000-V overhead transmission to South Grafton. The Bathurst (N.S.W.) Council is taking steps to raise £40,000 for the institution of an electricity supply scheme.

Bann Electricity Scheme.—Opposition to Bill.—At a meeting of the Belfast Corporation on June 1st, the Electricity Committee recommended that a petition be lodged against the North Ulster Electricity Supply Bill. Alderman Oswald Jamison, chairman of the Electricity Committee, said that the company concerned was seeking powers to supply electricity in the counties of Antrim and Down, and the object of the Corporation was to protect itself with regard to the future supply of electricity, so far as the city was concerned.

Barnstaple.—Electricity Charges.—The Town Council is applying to the Electricity Commissioners for authority to maintain the existing maximum charge for electricity after the expiration of the present Order. The minimum charge for electricity for lighting will be 5s. for the summer quarters and 7s. 6d. for the winter quarters.

Barton-on-Humber.—Electricity Charges.—The Urban Council has decided to oppose the application of the Barton Electric Supply Co., Ltd., for an Order authorising the charge for electricity supplied to private consumers to be increased from 10d. to 1s. per unit.

Bath.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £20,000 for the following purposes:—Generating plant, £11,000; and motor-generator and sub-station plant, £9,000.

Burnley.—Proposed New Power Station.—The Town Council has under consideration a proposal to erect a new power station in the district of Padiham. The Lancashire Electric Power Co. has also stated that it is willing to undertake the scheme. The Electricity Committee has decided to pay a visit to the proposed site before coming to a final decision.

Bexhill.—Year's Working.—The report of the borough accountant on the electricity undertaking for the year ended March 31st last records a gross profit for the year of £13,245, an increase of £3,010 on that of the previous year. The working costs decreased by £3,164, while the income decreased by £64. After making provision for repayment of loans, income tax, &c., there remained a net profit on the year's working of £5,032, as compared with £2,122 in the previous year.

Price Reductions.—The following reductions in the charges for electricity are to be made as from the end of September:—Lighting: From 8d. to 6d. per kWh. Power: From 2½d. to 2d. per kWh.

Brighouse.—Electricity in Bulk.—The Electricity Committee is negotiating with the Yorkshire Electric Power Co., Ltd., for a bulk supply of electricity.

Canada.—Hydro-electric Development.—The Hollinger Consolidated Gold Mines Co. is preparing plans for the development of hydro-electric power at Virgin Falls on the Abitibi River. The estimated cost of the scheme is $4,000,000.—*Reuter's Trade Service* (North Bay, Ont.).

Continental.—Belgium.—A new 6,000-kW steam turbine generating set is being installed at the Sclessin generating station of the Société d'Electricité du Pays de Liége. In order to meet the growing demand for electricity in the district, mainly for power purposes, the company has also decided on the establishment of a new generating station at Amay, between the River Meuse and the Namur-Liége railway. It will be equipped with two 6,000-kW turbo-generators, and is expected to be ready for operation by next winter.

Finland.—A visit of inspection was recently made by the Finnish State Water Power Administration to Imatra, where the preliminary works in connection with the projected hydro-electric station are being carried out. It is now estimated that the total expenditure will amount to 330,000,000 Finnish marks. The transmission lines will follow the route of the

railways to Rükimaki and Helsingfors. Applications for an electricity supply have already been received to such an extent as to ensure the commercial success of the undertaking.

Germany.—On June 1st, following the lead of the tramway men, workers in the municipal and public services of Cologne, including the gas, water, sanitary, and electricity supply branches, commenced a strike. The labour disputes, failing a settlement by mutual agreement, will render arbitration compulsory, but the enormous increase in the cost of living, which rose 26 per cent. in 12 days, has caused the workmen to repudiate the decision for arbitration, against the advice of their leaders. They have also rejected the proposal to refer the disputes to the Central Arbitration Board at Berlin.—*Reuter* (Cologne).

Dundee.—Correction.—In a note bearing the heading, "Dundee.—Change-over," which appeared in our last issue, it was announced that the supply in the Cults area was being changed from d.c. to a.c. The area in question is in the Aberdeen district, and is supplied by that town's undertaking.

Godstone.—Electricity Supply.—The Rural Council has received notice from Messrs. W. O. Rooper & Co., stating that application is being made to the Electricity Commissioners for an Order sanctioning the erection of a power station at Lingfield, and power to supply electricity in the district.

Hastings.—Year's Working.—The report on the working of the electricity undertaking for the year ended March 31st last shows a total revenue of £51,972, as compared with £49,469 in the previous year. Working expenses amounted to £26,716 (£33,215), leaving a gross profit of £25,256. After providing for interest, capital charges, &c., there was a net profit of £11,090. The previous year's net profit was £4,363. The amount of energy sold was 2,088,120 kWh, an increase of 342,993 kWh. It is proposed to place £2,000 to the relief of the rates.

Henley-on-Thames.—Electricity Supply.—The Rural and Town Councils have approved the draft Order of the Thames Valley Electric Supply Co., Ltd., for the supply of electricity in the district, provided that no overhead wires are used in the borough.

Hove.—Inquiry.—The Electricity Commissioners held an inquiry on May 30th into the application of the Corporation for sanction to borrow £20,000 for the erection of a new sub-station in Hove Street. Objections are raised against the scheme, as it is stated that the erection of the station would depreciate the value of surrounding property.

Ilford.—Extension of Supply.—The Urban Council is applying to the Electricity Commissioners, the County of London Electricity Supply Co., Ltd., and the Romford Rural Council for sanction to supply electricity to consumers in the vicinity of Chadwell Heath. A loan of £16,750 for electricity purposes has been applied for.

India.—Fire at Calcutta.—The Calcutta correspondent of *The Times* reports that a serious fire occurred on June 4th at the power station of the Electric Supply Corporation, putting 30,000 h.p. of plant out of commission. The stoppage of power caused the closing down of many factories and workshops, and some districts were deprived of lighting and motive power. On June 5th the Calcutta Electric Supply Corporation's London office received a cable stating that the cause of the fire was the burning-out of the stator of an old Oerlikon generator, which deranged certain of the auxiliaries. A partial supply, however, was renewed within three hours of the fire; and by noon on June 4th all domestic supplies and essential industries were being met. The station is fortunate in an abundance of modern plant, which is being rapidly enlarged, so that the trouble is purely temporary.

Leatherhead.—Electricity Charges.—The Leatherhead and District Electricity Co., Ltd., has applied to the Ministry of Transport for an Order to continue the maximum charge of 1s. per unit, with minimum payments of 15s. for each winter quarter and 10s. for each summer quarter.

London.—St. Marylebone.—*Loan Sanctioned.*—Sanction has been received from the Electricity Commissioners to the borrowing of £30,000 for building work, making a total of £225,500 sanctioned on account of the £292,367 required. The Commissioners have reiterated their refusal to permit the suspension of sinking-fund payments for a period of two years.

Year's Working.—The Electric Supply Committee reports that the revenue accruing to the electricity undertaking during the year ended March 31st last was £383,487, as compared with £377,094 in the previous year, in spite of two reductions made in the charges during the period under review. The working expenses amounted to £212,061, as against £220,428, leaving a gross profit of £171,426 (£156,666). Capital charges were higher at £134,190 (£126,556), but the net profit of £37,236 was a considerable advance on that of the previous year—£30,110. The amount of energy sold was 35,820,559 kWh, an increase of approximately 48 per cent. The costs per kWh sold fell from 1.949d. to 1.265d., and the actual generating costs from 1.165d. to .731d.

Price Reduction.—In view of the large profit made, the Committee has decided to reduce the flat rate to 5½d. per kWh instead of 6d., as originally proposed, and the price of energy supplied through slot meters will also be reduced by 1d. to 6d. per kWh.

Malvern.—Loan.—The Urban Council has applied to the Electricity Commissioners for sanction to a loan of £3,000 for cables, transformers, meters, &c.

Newark.—Electricity Scheme.—The Town Council is approaching the local gas company with a view to the transfer of its undertaking to the Council to be worked in conjunction with an electricity supply scheme. The Council is also negotiating with the Lincoln and Nottingham Town Councils for a supply of electricity in bulk.

North Somerset.—Special Order.—The North Somerset Electric Supply Co., Ltd., is applying to the Electricity Commissioners for a Special Order authorising it to supply electricity in certain parishes in the rural districts of Axbridge and Long Ashton.

Paisley.—Electricity Supply.—The Corporation electrical engineer has recommended that a partial bulk supply be taken for a year and used in conjunction with the town supply, to enable the Corporation to decide whether it shall close the Paisley works down and obtain the entire supply in bulk.

Perth.—Inauguration of New Plant.—A new steam turbine driving a 500/550-V, 1,000-kW generator was formally brought into operation on May 29th. The boiler plant was installed by Messrs. Babcock & Wilcox, Ltd., and the generating and condensing plant by Messrs. W. H. Allen, Sons & Co., Ltd.

Peterborough.—Electricity Supply.—The Town Council has decided to lay a new main along Lincoln Road for supplying electricity to a new wagon works at Walton. The cost, including the erection of a sub-station, is estimated at £2,750. The charge for electricity for lighting purposes is to be reduced to 8d. per kWh.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

Accrington.—Lighting: 6d. per kWh. Heating: 1½d. per kWh. Power: 3½d. per kWh for the first 100 kWh: 1½d. to .80d. per kWh to large power consumers.

Bolton.—Lighting: From 5d. to 4½d. per kWh. Heating and cooking: From 1.90d. to 1½d. per kWh. Power: From 2.90d. to 2½d. per kWh for the first 500 kWh per quarter. All energy in excess of this amount, from 2.10d. to 1½d. per kWh.

Elland.—Lighting: 7½d. per kWh, less 12½ per cent., for prompt payment of accounts. Power: 2d. per kWh.

Chesterfield.—Lighting: 5½d. per kWh. Heating and cooking: 1½d. per kWh. Small power consumers: First 500 kWh per quarter, 2½d. per kWh; next 500 kWh, 2d. per kWh; next 1,000 kWh, 1½d. per kWh; next 3,000 kWh, 1½d. per kWh; all energy above this amount, 1½d. per kWh. Large power consumers, £6 per kVA per annum, plus .4d. per kWh consumed. Current supplied through prepayment meters is to be charged for at the rate of 6½d. per kWh consumed, this including meter rent.

Saddleworth.—Electricity Supply.—The Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board has adopted a resolution declining to transfer or agree to the revocation of the Joint Board's powers for the supply of electrical energy in the area of Saddleworth and Springhead, which the Yorkshire Electric Power Co. desires to supply.

Shoeburyness.—Electricity Supply.—At a recent meeting of the Urban Council it was reported that the Commanding Royal Engineer was willing to meet a deputation from the Council on the question of an electricity supply for the district.

Shrewsbury.—New Plant.—The Corporation has installed two new 165-kW generators, coupled to two 250-h.p. Diesel oil engines, at the electricity works, which were started up on May 28th. The total cost of the extensions was £15,000.

TRAMWAY AND RAILWAY NOTES

Birmingham.—Year's Working.—The working of the tramways undertaking for the past year shows a gross profit of £450,000, and, after paying interest, sinking fund, and other charges, there is a net profit of £240,000, as compared with £192,541 in the previous year. Of this, £200,000 has been used in payment for reconstruction work which has been undertaken during the year. The balance is carried to the reserve fund.

Operation of System.—The Tramways Committee has recommended that the West Bromwich tramways be operated by the Corporation after March 31st next year, the date upon which the existing lease of these tramways to the South Staffordshire Tramways (Lessee) Co., Ltd., expires.

Blackburn.—Year's Working.—The report of the general manager of the Corporation's tramways (Mr. J. H. Cowell) for the year ended March 31st last, records a total income of £129,488, comparing with a revenue of £125,765 in the preceding year. Working expenses amounted to £96,327, as against £101,497 in 1921-22, leaving a gross profit of £33,161 (£24,268). Capital charges absorbed £11,868 (£24,277), and there was credited £66 interest (£1,655), making the final result a profit of £21,358, as compared with £1,646 in the previous year. The car-mileage increased from 1,076,765 to 1,171,054, and the number of passengers carried from 15,658,815 to 16,389,348. £8,000 was allocated to the relief of the rates.

Bolton.—NEW ROUTE.—The Chorley Old Road tramway extension is now complete and ready for use. Application has been made for sanction to the use of the line for passenger service, and the general manager has been instructed to inaugurate a service of cars as soon as permission is received.

Continental.—SPAIN.—Application has been made by the Banco Español de Credito for a concession to construct an underground railway at Bilbao. The line will run from Achuri to the Casilla.

Halifax.—TRACK RENEWALS.—The Tramways Committee has recommended the Town Council to carry out reconstruction of the track between Hebden Bridge and Brearley at an estimated cost of £33,000.

Leicester.—NEW ROUTE.—The Tramways Committee proposes to lay a special tramway track along Blackbird Road in preparation for the Royal Show, which is to be held in the town next year.

TELEGRAPH & TELEPHONE NOTES.

Belgium.—STRIKE ENDED.—The strike of Post Office, telegraph, telephone, and railway employés in Belgium has ended; the workers resumed their duties on the 1st inst.

The Telephone Service.—NEW CLYDE CABLE.—A new cable across the Firth of Clyde provides two telephone trunk circuits between Glasgow and Brodick, on the Island of Arran.—*The Times.*

NEW EXCHANGES.—No fewer than 38 new telephone exchanges and call offices are being opened within the next fortnight in various parts of the country.—*Financier.*

HULL PROFITS.—The Hull Corporation Telephones Committee reports a net profit of £14,000 on the past year's working. A sum of £11,000 was paid to the Government in royalty tax.—*Financial Times.*

RADIO-TELEGRAPHY AND TELEPHONY.

Bulgaria.—RADIO COMMUNICATION.—Regular communication by means of radio-telegraphy has been established between Bulgaria and Moscow in Russia, says the *Evening News.*

Radio-Broadcasting.—5IT REMOVAL.—It is expected that the new studio for the Birmingham broadcasting station will shortly be completed. It will be near the Summer Lane power station. The new studio will permit of much better programmes being transmitted, for hitherto it has been difficult to persuade artistes and bands to make the long journey out to Witton, which is on the city boundary. The Summer Lane studio will be more or less centrally situated, and it is proposed to connect it by land line to some of the places of entertainment in town, so that performances may be broadcast occasionally from these centres.

Switzerland.—RADIO-TELEGRAPHY.—Experiments have been carried out at the Münchentuchsee (Berne) station in the reception of American radio messages. The success attained was such that a regular public service was to be opened on June 1st.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

OPEN.

Australia.—MELBOURNE.—August 31st. Electricity Commissioners. Aluminium steel-cored cable. (May 25th.)

SYDNEY.—November 19th. City Council. Storage batteries, regulating switches, copper connections, charging boosters, and switchgear (spec. 736). Spec. (21s.) from the City Treasury, Town Hall, Sydney.

July 2nd. Vacuum tungsten and carbon-filament electric lamps.*

BRISBANE.—July 31st. Postmaster-General's Department. Cable terminals.*

Barnes.—June 11th. Urban District Council. One electrically-propelled dust-collecting van. Mr. G. B. Tomes. engineer and surveyor, Council Offices, High Street, Mortlake, S.W.14.

Belgium.—BRUSSELS.—June 13th. Ministry of Railways, Marine, Posts and Telegraphs. 82 lots of cables, wires, and electrical accessories.*

June 12th. The Belgian Post and Telegraph authorities, at La Salle Madeleine, Brussels. Twelve lots, totalling 580 tons, of bronze wire for the telegraphic and telephonic service.

Fresh tenders have this week been invited by the municipal authorities of Rothem for the establishment and maintenance during a period of 10 years of an electricity distribution system in the villages of Neeroeteren, Storkteim, Dilsen, Rothem, Eelen, and Lanklaer (Province of Limbourg).

Bristol.—July 2nd. Docks Committee. Two 2-ton movable electric jib cranes. Mr. T. A. Peace, Chief Engineer's Office, Avonmouth Docks, Bristol.

Dumfries.—June 19th. Joint Sanatorium Board. Electric lighting, &c., plant and fittings for the sanatorium at Lochmaben. Mr. W. Arnott, electrical engineer, 163, Hope Street, Glasgow.

Eccles.—June 25th. Electricity Committee. Single-phase a.c. watt-hour meters for 12 months. (See this issue.)

Epsom.—June 12th. Electricity Department. One 200-kW d.c. generator, direct-coupled to a 300-h.p. heavy oil engine; feeder and pilot cables, feeder pillars and joint boxes. (June 1st.)

Glasgow.—June 11th. Education Authority. Electric lighting installation at 12 schools. Specifications from 129, Bath Street, Glasgow.

Grimsby.—July 2nd. Electricity Department. Two water-tube boilers, with economisers, stokers, steel chimney, &c., one 1,000-kW converter, one 250-kW converter, l.p. switchgear, cables, &c. (See this issue.)

Kendal.—June 14th. Electricity Department. Overhead l.p. transmission line. (June 1st.)

Kirkcaldy.—Fife Education Authority. Electric lighting of Denbeath school, Buckhaven. Mr. Geo. Sandilands, master of works, Education Offices, Wemyssfield, Kirkcaldy.

Leeds.—July 2nd. Electricity Department. Single-phase and 3-phase, Scott-connected transformers. (June 1st.)

July 31st. Electricity Department. 10,000-kW steam turbine, three-phase alternator and exciter, and auxiliaries for surface-condensing plant. (See this issue.)

Leicester.—June 23rd. Electricity Department. One 12,500-kW, 3-phase turbo-alternator, with condensing plant, and one 500-kW house service turbo-alternator. (May 25th.)

Leyton.—June 26th. Education Committee. Electric lighting installation and central heating system at the Canterbury Road boys' school. (See this issue.)

London.—INDIA STORE DEPARTMENT.—June 15th. V.i.r. copper wire. (May 25th.)

Manchester.—June 12th. Tramways Committee. Sand-drying apparatus. Copper, also silicium bronze or other super-hard trolley wire. Mr. H. Mattinson, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

June 18th. Rivers Committee. Electric lighting installation at the Davyhulme sewage works. Secretary of the Rivers Committee, Town Hall, Manchester.

New Zealand.—WELLINGTON.—July 31st. Public Works Department. Metering equipment in connection with the Lake Coleridge power scheme.*

July 31st. Oscillator testing set for the Mangahao power scheme.*

AUCKLAND.—June 28th. City Council. 1,460 tons of rails, with accessories. Specifications may be inspected at Messrs. Downie Bros., 7, Fenchurch Avenue, E.C.

Nottingham.—June 14th. Electricity Committee. General stores for 12 months. Electrical engineer, Talbot Street.

Portsmouth.—July 3rd. Tramways Committee. Stores for 12 months, including electrical items. (See this issue.)

South Africa.—RIVERSDALE (CAPE PROVINCE).—July 31st. Municipal Council. Generating plant, l.p. distribution material, meters, &c.*

WORCESTER (CAPE PROVINCE).—August 2nd. City Council. Additional generating plant for the power station.*

WINDHOEK.—June 30th. Municipal Council. Storage battery and equalising booster.*

Southend-on-Sea.—Light Railways and Electric Lighting Department. One steel surface tramcar traverser, one tower wagon (petrol or electrically driven), 10,000 tons of coal. (June 1st.)

Tunbridge Wells.—June 23rd. Electricity Department. Water-tube boilers, stokers, and economisers; e.h.p. and l.p. 3-phase switchboards; Scott-connected and 3-phase transformers; two 1,000-kW turbo-alternators, with condensers, and air filters; steam, feed, exhaust, circulating, and drain-pipework. (See this issue.)

Uruguay.—MONTEVIDEO.—July 12th. State Electric Light Works. General stores.*

Warrington.—June 26th. Electricity Department. H. and l.p. cable. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

(Continued on page 903.)

THE INSTITUTION OF ELECTRICAL ENGINEERS ON TOUR.

Summer Meeting in Lancashire and North Wales.

To the mechanicians of the 18th century the City of Manchester was the centre of attraction. There it was that the intervention of science in human affairs first began to manifest itself, and the city continued to be the home of engineering and scientific discovery well into the 19th century. While two of her greatest citizens, the physicists John Dalton (1766-1844), author of the atomic theory, and James Prescott Joule (1818-1889), one of the founders of electrical science, were elaborating their speculative ideas, William Fairbairn (1789-1874) was developing the Lancashire boiler and undertaking practical work, such as the construction of the tubular railway bridges across the Conway and the Menai Straits in North Wales.

It was about the middle of the 19th century that the engineering firms which made the incorporated town of Manchester one of the greatest engineering settlements in the world began to congregate on the outskirts of the town; the origin of engineering in Manchester was at Ancoats, in the east, though that seat has in modern times been balanced by Trafford Park, in the west, and in the growth of the latter one landmark may be noted: electrical engineering began on a large scale at Salford 41 years ago. It was therefore fitting that most of the 425 participants (including over 100 ladies) in the Summer Meeting of the Institution of Electrical Engineers at its North-Western and Mersey and North Wales (Liverpool) Centres should have assembled in front of the Manchester Town Hall on Tuesday morning last, where they divided into three parties for conveyance by motor charabanc to the works that were to be visited.

The electrically-driven rolling mill at the Bradford Iron Works of Messrs. R. Johnson & Nephew, Ltd., was one of these, another being the Rochdale Mills of the No. 2 Dunlop Rubber Cotton Mills, Ltd., the electrical equipment of which is described in the following pages. The third alternative visit was to the engineering works of Messrs. Mather & Platt, Ltd., whose business was established nearly 100 years ago by the great-grandfather of the present chairman. The firm's first works at Salford were chiefly concerned with the production of textile machinery; the present textile department shows a wonderful variety, dealing with no fewer than 300 different types of machine. In 1900 the new Parks Works at Newton Heath were commenced. The main shops consist of three bays 376 ft. long, ten bays 550 ft. long, and four bays over 600 ft. long—all seven bays being under one roof, without a gallery or step, and having only one partition.

In the early 'eighties an electrical department was added—the earliest dynamos made being Edison-Hopkinson machines—and during the last 20 years Messrs. Mather & Platt have specialised in the manufacture of a.c. and d.c. generators and motors and, more recently, of rotary converters. As regards electric traction they were pioneers, for in 1885 they equipped the Bessbrook & Newry Railway, one of the first lines in the world to be electrically operated, and in 1891 they undertook the complete electrical equipment, including electric locomotives, of the City & South London Railway, the first underground tube electric railway to be constructed. In 1893-96 they equipped the Douglas and Laxey Electric Tramway and the Snaefell Mountain Electric Railway, in the Isle of Man, and, shortly afterwards, the Blackpool and Fleetwood tramroad. The hydraulic department has for many years been an important portion of the works, and a few years ago a chemical plant department was constituted, while the fire engineering department needs no introduction, for it is the producer, amongst other fire-fighting appliances, of the Grinnell sprinkler, with which it is claimed about 50,000 buildings are now protected; the sprinklers have operated in over 24,000 fires, the damage being under £60 per fire. Three years ago a research laboratory was established, and the firm's works school, which all the younger apprentices attend during working hours, was one of the first of such institutions to be recognised by the Board of Education under the new Education Act. Amongst other educational activities, evening classes for members of the staff are held on the premises.

On returning from the morning visits, a civic reception was held by the Lord Mayor (Councillor Wm. Cundiff) at the Midland Hotel, Manchester, where the members partook of luncheon as the guests of the Corporation Electricity and Tramway Committees.

In the afternoon, motor charabancs again conveyed members in parties to the four undermentioned works at Clifton Junction, which had been thrown open for inspection. The Pilkington Tile and Pottery Co., Ltd., commenced the manufacture of tiles in 1893, and some years later introduced the artistic "Royal Lancastrian Pottery" ware. The methods in use range from the potter's wheel to the modern tile press, which forms the tiles under steel dies from damp clay powder. A considerable amount of handicraft and handwork still remains in the industry, and power-driven machinery is used to a much less extent than in others. The company has recently installed modern firing plant for glazing purposes; it is built on the continuous tunnel principle, and is heated entirely by producer gas.

Neither the batteries manufactured by the Chloride Electrical Storage Co., Ltd., nor the Clifton Junction factory wherein they are produced need introducing, for both have been described in our pages, and visitors were able to see for themselves every stage of manufacture. The company employs about 1,000 hands, of which a comparatively small proportion is female labour. In addition to the main processes, innumerable minor operations were watched with interest, and the arrangements made for the reduction of the risk of lead poisoning to a minimum, together with the precautions taken in the matter of cleanliness and welfare of the staff, were appreciated. The firm has provided a spacious canteen, playing fields, &c., and recreation—which forms such an important feature of most modern works—is efficiently catered for by a very live Recreation Club.

The electrified Manchester-Bury section of the London, Midland and Scottish Railway was opened in 1916, and the conversion has been justified by the results; its length is about 100 miles, and it is the only section of railway in the Manchester district to be electrified as yet. The power station at Clifton Junction—4¾ miles from Manchester on the main line to Bolton—is adjacent to extensive coalfields, and water is obtained from the Manchester, Bury and Bolton Canal, which is owned by the Railway Company. The power station is 37 ft. below the level of the main line, which at this point is carried on an embankment, and thus coal wagons can run directly over the tops of the coal bunkers. Hence the necessity of installing coal-handling plant is obviated. Particulars of the plant installed will be given in a later issue.

The boiler room contains four Babcock & Wilcox water-tube boilers, each having a normal evaporation of 32,000 lb. of water per hour, from and at 212 deg. F., the steam pressure being 200 lb. per sq. in. gauge, superheated to 700 deg. F. at the stop valve. Chain grate stokers give a grate area for each boiler of 144 sq. ft.; the heating surface is 7,135 sq. ft.; and the superheating surface is 2,635 sq. ft. Green economisers are used and induced-draught fans. The ashes are dealt with by means of suction plant. A 30-ton weighing machine is provided on the approach roads for checking the coal supply.

Two main turbo-alternator sets of 5,000-kW capacity, by Messrs. Dick, Kerr & Co., Ltd., and one 500-kW

geared turbo-alternator, by the British Westinghouse Co., Ltd., are installed. Each alternator consists of a "D.K." two-pole, three-phase machine, generating at 6,600 volts, 25 cycles, at a speed of 1,500 r.p.m., and has its own exciter on the end of the main shaft. The condensing plant was manufactured by Messrs. W. H. Allen, Son & Co., Ltd. The surface condensers deal with 82,000 lb. of steam per hour, and are capable of maintaining a vacuum of 28.1 in. (barometer 30 in.) at full load when supplied with cooling water at the rate of 6,700 gallons per minute at a temperature of 75 deg. F. Heenan & Froude wet air filters are provided, each capable of dealing with 25,000 to 30,000 cu. ft. of air per minute. All auxiliary motors are supplied at 440 volts a.c. The 500-kW set generates at 440 volts, 25 cycles. This set is also provided with its own surface condenser on the Westinghouse-Leblanc system, and is capable of maintaining a vacuum of 27.5—28.5 in. (barometer 30 in.) on full load when supplied with cooling water at the rate of 784 gallons per minute at a temperature of 75 deg. F. The gearing gives a speed reduction of 3,600/750 r.p.m. The condensing water from the canal passes through a bar screen, and then through rotary screens. The two rotary screens, each 10 ft. in diameter, revolving at 1 r.p.m., are driven by Pelton wheels through worm gearing. In conjunction with the canal a cooling pond has been provided, with spray nozzles and pipes for cooling purposes.

The switchgear, manufactured by the British Thomson-Houston Co., Ltd., is of the solenoid remote-control type. The voltage of the control circuits is 125. There are installed in the turbine room two 250-kW, three-phase transformers, by the British Electric Transformer Co., for transforming from 6,600 to 440 volts or *vice versa*. D.c. at 125 volts is obtained by means of two 50-kW rotary converters, by the British Westinghouse Co., operating through transformers from the 440-volt supply, in conjunction with a 70-cell battery, by the Chloride Electrical Storage Co., Ltd.

Current is conveyed at 6,600 volts a.c. from the Clifton power station north, to Radcliffe sub-station, and south, to Victoria sub-station, by means of bare overhead conductors in open country, and three-core cables, lead-covered and armoured, on short stumps and brackets in congested areas. Each sub-station is a combined battery and rotary station, and is equipped with four rotary converters, manufactured by Messrs. Dick, Kerr & Co., Ltd., of 1,000 kW, six-phase, 25 cycle, 10-pole, and 300 r.p.m., with an induction motor on the end of the main shaft for starting and self-synchronising. Three transformers are used for each rotary converter, each of 350 kVA with a voltage ratio of 6,600/900. An Entz booster of the automatic reversible type with carbon regulator is installed in the sub-station. The battery, housed in a separate building, consists of 620 cells. The capacity of Radcliffe sub-station battery is 800 ampere-hours, and that at Victoria sub-station 500 ampere-hours. A charging and milking booster is provided and installed in the rotary room. The switchgear is in two portions: (1) ironclad truck type controlling the high-pressure feeders and transformer leads, and (2) the "flat-board" type for controlling the 1,200-volt d.c. rotaries, battery, booster, and live rail.

Current is supplied to the trains by means of a third rail which has a side-running contact, and readily lends itself to guarding. The return circuit is completed by means of the track supplemented by a "fourth" rail of square section laid in the middle of the track, and cross bonded to the running rails.

The train motor bogie carries two 200-h.p. motors geared to the axle through spur gearing, the ratio being 25/39. Each motor car is provided with two bogies, making a total of four motors, or 800 h.p. per car. The motors are designed for 1,200 volts, series wound with commutating poles, and are totally enclosed. The experience of commutation at 1,200 volts has been very gratifying. The wear is almost infinitesimal, and the commutators are ground on an average only once every 80,000 miles. It is estimated that the life of the commutator under present conditions and service will be approximately 40-50 years. The control equipment of the cars is on the shunt multiple unit system, and is operated on the automatic principle. Manual operation can be resorted to when required. The whole of this equipment is operated by 100 volts d.c. Metal has entirely superseded wood in the construction of the cars.

The Radcliffe generating station of the Lancashire Electric Power Co., which was also visited during the afternoon, we hope to describe in due course. Afternoon tea was provided by the company at the power station, and also on "Crompton Fold," opposite its works, by the Chloride Electrical Storage Co., Ltd.

On the outward journey the motor charabancs made a detour past the site of the new generating station that is being built by the Salford Corporation at Agecroft. The county borough first commenced to supply electricity in 1895 from a station of a total capacity of 360 kW on the river Irwell, the supply being single phase at 3,000 volts, which pressure was transformed on the premises of each consumer. The Frederick Road station, on the Manchester, Bolton and Bury Canal, started in 1901 with a complete d.c. lighting, power, and traction supply, the capacity of the plant being 6,400 kW of reciprocating engines and Lancashire boilers; subsequently 1,000-kW d.c. turbines and one Babcock & Wilcox boiler were installed. The first a.c. turbine of 5,000 kW at 1,500 r.p.m. was installed in 1914, and since that date the whole of the original plant has been replaced by four 5,000-kW a.c. turbines, and 7,000 kW of rotary converting plant.

The last turbine was installed by the Metropolitan-Vickers Electrical Co. in 1921, and is a 3,000-r.p.m. machine with feed water heating by steam diverted from the turbine, and a closed air circuit on the alternator. Two additional Babcock & Wilcox boilers were installed in 1917.

In 1913 an agreement was entered into with the Lancashire Electric Power Co. for a bulk supply of 2,000 kW, which was continued until 1919, when an agreement was entered into with the Manchester Corporation for a bulk supply of 4,000 kW, which has since been increased to 5,000 kW. This supply is delivered at a pressure of 33,000 volts to Frederick Road, where it is stepped down by means of a bank of three single-phase Metropolitan-Vickers transformers to 6,600 volts at the common busbars of the power station.

It is interesting to note that the power station, which was fully occupied in 1901 with plant of a capacity of 6,400 kW, now contains 20,000 kW of generating plant, 7,000 kW of converter plant, and 5,000 kW of transforming plant for the bulk supply without material increase or alteration in the original buildings. When the possibilities of extension at Frederick Road were exhausted a site was acquired on the River Irwell at Agecroft, on which a new power station with an initial capacity of approximately 50,000 kW is being erected. The site comprises 65 acres, and practically the whole of the rough excavation was completed in June, 1922, under the scheme of the Unemployed Grants Committee for finding work for the unemployed. Work under the building contract started at the beginning of this year and is now in full operation.

The capital cost of the station is estimated at £709,287, and it is interesting to note that the outstanding debt of the original plant at Frederick Road will be entirely liquidated by 1925 with a saving in standing charges of £32,000 per annum.

In the evening the proceedings of the first day of the meeting were brought to a close with a reception at the Town Hall, held by the Lord Mayor and Lady Mayoress of Manchester (Councillor and Mrs. Cundiff). The attendance numbered no fewer than 800 guests, and the function was very successful. Apart from slight rain in the evening, which the Clerk of the Weather doubtless considered indispensable for the sake of local colour, fine weather prevailed during the day.

THE ELECTRICAL EQUIPMENT OF A COTTON MILL.

The No. 2 Dunlop Rubber Cotton Mills.

On Tuesday last, during the Summer Meeting of the Institution of Electrical Engineers in Lancashire, a visit was paid to the Rochdale mills of the No. 2 Dunlop Rubber Cotton Mills, Ltd. The mills in question are entirely electrically driven, and consist of large spinning and weaving establishments equipped with up-to-date machinery for the production of cotton cord, fabric, &c., used in the manufacture of the well-known Dunlop cord tires. The total floor area is about 34 acres.

Fig. 1.—The New Spinning Mill.

Electricity, although purchased from the Rochdale Corporation, is supplied on behalf of the latter by the Lancashire Electric Power Co., Ltd., from Radcliffe, approximately 10 miles away. Four feeders, which are carried principally overhead, enter the two transforming sub-stations situated at the mills, the transmission pressure being 10,000 volts (3-phase, 50-cycle).

One of the two 10,000/400-volt sub-stations has an ultimate capacity of 10,000 kVA, and supplies the spinning mills, and the other an ultimate capacity of 6,000 kVA for supplying the weaving mills. The whole

Fig. 3.—Low-pressure Switchboards.

of the e.h.p. and l.p. switchgear, with slight exceptions, has been supplied and erected by the British Thomson-Houston Co., Ltd. Fig. 2 shows the e.h.p. switchboards, which are of the stone-cell type, with hand-operated remote control, whilst fig. 3 shows the l.p. switchboards, which are of the open slate type erected on a gallery. The transformers, supplied by the British Electric Transformer Co., Ltd., are oil cooled and stand in separate brick cubicles; each has a capacity of 1,500 kVA. Single-wire armoured, lead-covered, paper-insulated cable connects the l.p. switchboards in the sub-stations to the industrial-type distribution switchgear in the new spinning mills, whilst in the older mills, existing cable has been retained in use.

The staircase tower which adjoins the sub-station was designed to accommodate the cables and distribution switchgear, a switch room being provided on each floor.

Fig. 2.—B.T.H. High-pressure Switchboards.

One of the walls of this tower is used to carry the main feeder cables from the sub-station to the various switch rooms; fig. 4 shows the method by which these cables are supported, and fig. 5 shows the "unit"-type Reyrolle switchgear installed in each storey switch room. A separate circuit is taken from the above switchgear to each motor of 70 h.p. and upwards, whilst in the case of the 50-h.p. motors, three are grouped on one distributor, and only in the case of 20-h.p. and smaller motors are fuse boxes used. The distributor cables from the switch rooms to the various motors are carried on wrought-iron cable cleats bolted to cast-iron transverse beams which are carried on the floor beams; fig. 6, which is a view of a small portion of the doubling room, clearly shows how the cables are suspended. The whole of the cable was supplied and erected by Messrs. Siemens Bros. & Co., Ltd.

With the exception of the individual driving of the blowing room and the doubling machinery in No. 7 flat, the driving is all on the "group system." The motors, which are erected on stages near the outer walls, are pipe-ventilated and fitted with brush-lifting and short-circuiting gear. With the exception of the 250-h.p. motors, which have ring-oiled bearings, the whole of the motors are fitted with roller bearings.

The ground floor contains the blowing-room machinery, for which two standard types of motors are adopted. Sixteen 20-h.p. and thirty-two 6-h.p. motors drive individually the double opener and finisher scutchers respectively; they are of the Metropolitan-

Vickers squirrel-cage protected type, running at 970 r.p.m., and are fitted with automatic centrifugal clutch pulleys made by Messrs. Thos. Broadbent, of Huddersfield.

The second storey is devoted entirely to the doubling process. Owing to the immense size of this room and the power consumed by the doubling frames, the seven line shafts have been divided into two parts, each driven by one 250-h.p. motor, making a total of 3,500 h.p. for this flat. These motors are coupled direct to the line shafts, which run at 485 r.p.m.; fig. 7 shows one of these 250-h.p. motors, and some idea of the size of this room will be gathered from the fact that it has a floor area of 3¼ acres and contains 1,100 electric lights.

The third, fourth, fifth, and sixth storeys contain the carding and ring spinning machinery, each having six 50-h.p. motors for driving the carding engines, four 70-h.p. motors for driving the roving frames, and four 150-h.p. motors for driving the ring spinning frames, making a total of 1,180 h.p. for each of these four rooms. The motors driving the ring spinning and roving frame shafts are coupled direct through pin-type flexible couplings, the speed being 485 r.p.m. in each instance. Fig. 9 shows a 150-h.p. motor driving ring frames, and fig. 8 shows the 70-h.p. drive. In the case of the carding engine shafts, which run at only 200 r.p.m., the drive from the 3-bearing 50-h.p. motor is through a Hendry laminated belt, the motor speed being 585 r.p.m.

The seventh storey is used as a doubling, beaming, and winding room; owing to the light structure of the roof, the individual drive system is applied to the whole of the 76 doubling frames, which are erected in two rows. Fig. 11 illustrates the method adopted, although the photograph was taken when the doubling frames were running in a section of the new weaving mill. These squirrel-cage motors, 54 of which are of 10 h.p. and the rest of 12 h.p., are coupled direct and drive through Broadbent centrifugal clutch couplings.

The whole of the motors in the new spinning mill, with the few exceptions stated, were made by the English Electric Co., Ltd., at the Phœnix Works.

All motors above 20 h.p. are provided with control gear that consists of a triple-pole oil switch (fitted with no-volt and three overload releases and an ammeter) interlocked with an oil-immersed metallic-type rotor starter. Emergency switches are also fixed at suitable points in the rooms to stop any motor readily. For the motors of 20 h.p. and under, oil-break "star-delta" starters fitted with no-volt and three overload releases and an ammeter are provided. The whole of the motor-control gear was supplied by Mr. Geo. Ellison, Birmingham.

In the spinning mill alone nine 1-ton electric goods lifts have been installed by Messrs. Waygood Otis, Ltd. Two electric passenger lifts have also been provided by Medway's Safety Lift Co., Ltd., London.

Special attention was given to the efficient lighting of the various rooms—individual lighting with lamps of 40 or 60-watt "one-watt type" being preferred

Fig. 4.—Feeder Cables on Wall of Tower.

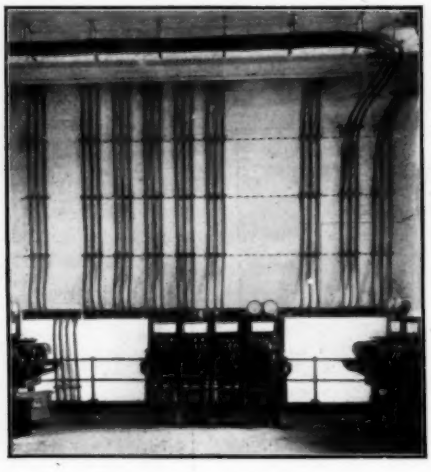


Fig. 5.—Switch-room, with Reyrolle Unit-type Switchgear.

Fig. 6.—Cable Run in Doubling Room.

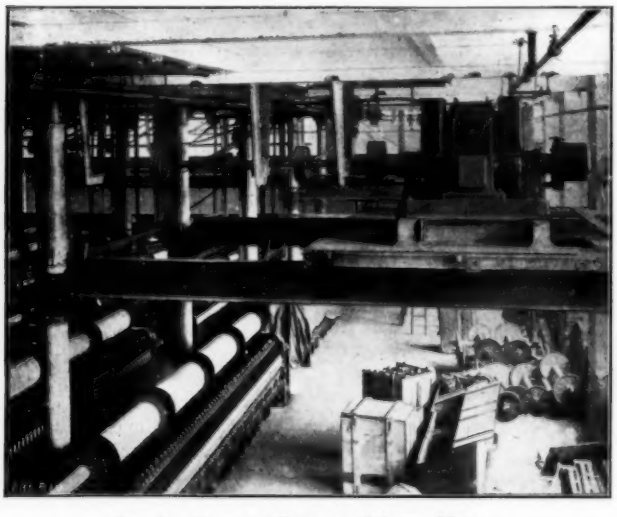


Fig. 7.—English Electric 250-h.p. Motor.

Fig. 8.—70-h.p. Motor driving Roving Frames.

to illuminate the spinning, doubling, and beaming machinery, whilst in the card and blowing rooms general lighting with lamps of the 100-watt gasfilled type was adopted. The lighting circuits are connected through the various ironclad distribution boards to Ellison industrial-type distribution switchgear fixed in the switch rooms, then through two 4-core cables to the two lighting panels on the switchboard in the sub-station, where a 230-volt supply is made available by a connection to the neutral point of the transformers. About 100 miles of cable and 40 miles of conduit has been used for lighting the spinning mill, in which there are over 4,000 lights. Practically the whole of the pendants are fitted with white enamelled 12-in. distributing-type Benjamin reflectors. The whole of the lighting has been carried out by Messrs. Fred. Rothwell, Ltd., Rochdale.

It will be noticed from fig. 1 that the spinning mill is provided with a large turret clock. This is operated in conjunction with 27 electric clocks fixed throughout the works. The whole of these clocks are controlled from one master clock situated in the engineer's office. The dials of the turret clock are 12 ft. in diameter, and are approximately 120 ft. above the ground level.

Fig. 9.—150-h.p. Motor driving Ring Frames.

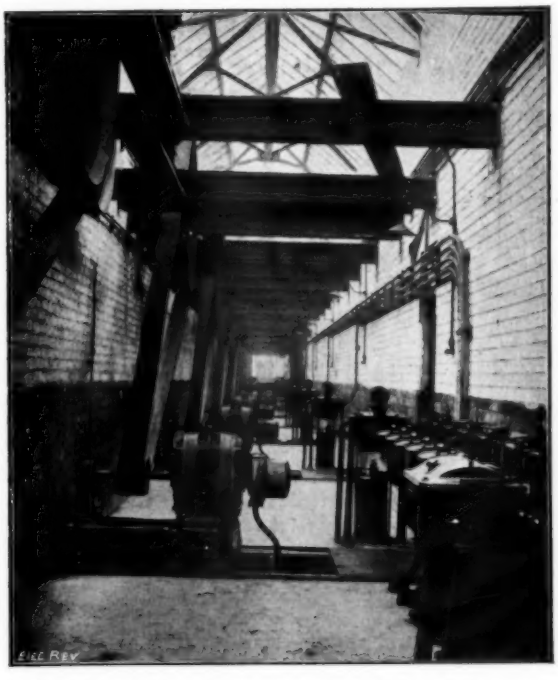


Fig. 10.—Motor Corridor in New Weaving Mill.

Signalling lamps, which come into operation at starting and stopping times, are also controlled from the clock system. The whole of the clocks were supplied by Messrs. Gent & Co., Leicester.

A private automatic telephone system has been installed by Messrs. Siemens Bros. & Co., Ltd.

Fig. 11.—Individually-driven Doubling Frames.

As the weaving mills are at present being rearranged, it is only possible to describe them briefly. The driving of the looms is all on the "group" system, special corridors being provided to house the motors and their drives to the various shafts; fig. 10 is a view of one of the new motor corridors. In the

case of the older mills, the motors were supplied by the General Electric Co., Ltd., and drive through laminated gears to the shafts, which run at 153 r.p.m.

A small fleet of electric trucks running on narrow-gauge lines has been supplied by the British Electric Vehicles, Ltd., Southport, with Exide batteries.

The whole of the electrical work has been carried out under the supervision of the Dunlop Rubber Co.'s engineering staff, Mr. A. B. Hopkins being the works engineer, to whom we are indebted for the above information and the photographs from which the accompanying illustrations were reproduced.

HIGH-PRESSURE OPEN-AIR SUB-STATIONS.

The 25,000-V Kilmarnock Installation.

In our description of the recent developments of the Kilmarnock Corporation's electricity undertaking,* mention was made of the fact that Mr. W. C. Bexon, the engineer and manager, supplied parts of his 400 sq. miles of territory by means of 3-phase, 50-cycle, overhead lines working at a pressure of 11,000 volts, some 50 farms *en route* being supplied with electricity for lighting, heating and power purposes through small pole transformers.

Some little while ago it was found necessary to increase the transmission pressure to the outlying portions of the area, and a new overhead line was accordingly erected to supply Kilbirnie and operate at a pressure of 25,000 volts. In order to economise in cost, outdoor type sub-stations were chosen, and by the courtesy of Mr. Bexon we are enabled to reproduce two photographs of one of the three such sub-stations that are now in commission. The accompanying illustrations show clearly the isolating switches, lightning arresters, choking coils, fuses, and also the automatic oil switches enclosed in small brick cubicles. The particular station illustrated provides for two incoming and two outgoing feeders, one feeder to the transformer that reduces the pressure from 25,000 to 11,000 volts, and also the 11,000-volt switchgear, the switching arrangement being such that the transformer can be switched into any of the four feeder circuits. Inside the transformer is the necessary potential transformer, and bolted to its outside case is a voltmeter enclosed in a water-tight cast-iron cover. Some of the transformers in the stations are wound in series-parallel so that either 11,000 or 22,000 volts can be obtained from them. The open-air switches that control the transformers are mounted vertically on the side of the steel lattice and girder structure, and they are all operated from the ground level by means of a long rod. There are fuses in series with the automatic switches.

This class of sub-station has been found to be much cheaper than brick buildings.

* Electrical Review, Dec. 1st, 1922; pp. 831-3.

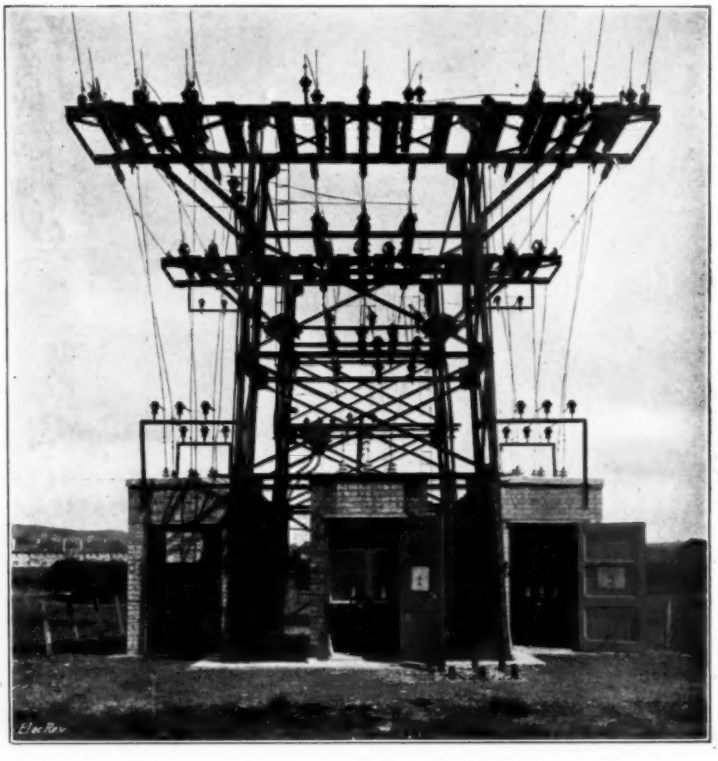


Fig. 1.—An Open-air Sub-station at Kilmarnock.

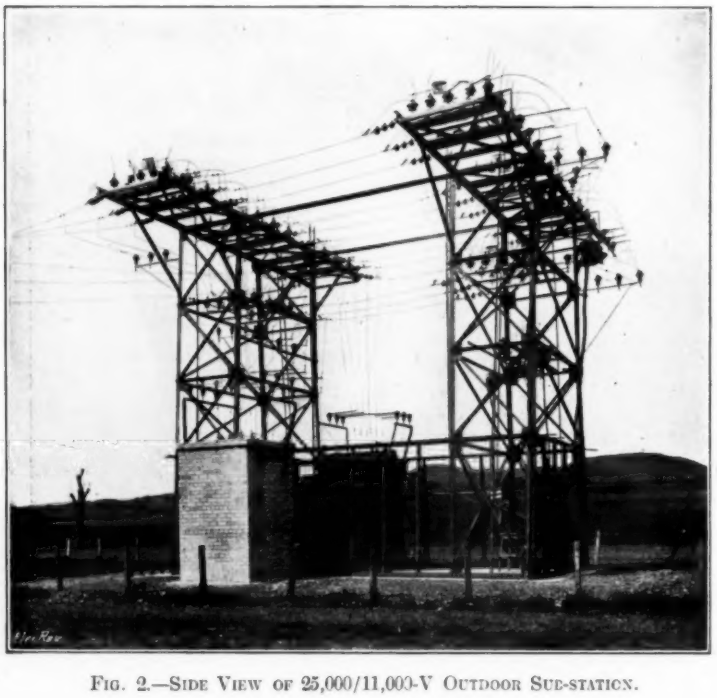


Fig. 2.—Side View of 25,000/11,000-V Outdoor Sub-station.

CONTRACTS CLOSED.

(*Continued from page* 896).

Barrow.—Town Council. Accepted:—
Overhead transmission line (£1,824).—Johnson & Phillips, Ltd.
Underground cables.—Enfield Ediswan Cable Works, Ltd.
E.h.p. switchgear, Anty-Cross (£482).—Ferguson, Pailin, Ltd.
E.h.p. switchgear, Abbey sub-station (£312).—Metropolitan-Vickers, Ltd.

Dublin.—Electricity and Public Lighting Committee. Supply of cables and accessories for a period of one year.

The following firms tendered for the cables:—Messrs. Watshams; the British Insulated & Helsby Cables, Ltd.; Callender's Cable & Construction Co., Ltd.; Deutsche Kabelwerke, A.G.; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; the Macintosh Cable Co., Ltd.; Pirelli-General, Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd. The tenders having been analysed, it was found that no one firm was the lowest for all the 41 items; that of the British Insulated and Helsby Cables, Ltd. (the usual suppliers of the department's requirements) was the lowest for the bulk of the items, and was the only one, the Committee states, in full conformity with the specification. This tender is recommended for acceptance by the Municipal Council, but it is also recommended that contracts should be entered into with the Deutsche Kabelwerke and Messrs. Watsham which would enable trial orders to be passed to these firms for low-pressure items.

For troughing, tenders were received from the following firms:—The British Insulated & Helsby Cables, Ltd.; the Hammond Lane Foundry Co., Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.; W. T. Glover and Co., Ltd.; Callender's Cable & Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; and Johnson & Phillips, Ltd. The quotations received from the Hammond Lane Foundry Co., Ltd., and the British Insulated and Helsby Cables, Ltd., were, the Committee reports, the lowest, and the same in every case. The tender of the Hammond Lane Foundry Co., Ltd., is recommended for acceptance for this section.

For section pillars, disconnecting boxes, &c., tenders were received from the British Insulated & Helsby Cables, Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.; W. T. Glover & Co., Ltd.; Callender's Cable and Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; and Lucy & Co., Ltd. Messrs. Lucy & Co.'s prices were the lowest, but their designs and also the new type of pillar of the British Insulated & Helsby Cables, Ltd., were not considered suitable by the Committee. Selecting the old type of section pillar, the Committee recommends for acceptance the tender of the British Insulated & Helsby Cables, Ltd., for the items in this section.—*Irish Builder and Engineer.*

Erith.—Urban Council. Accepted:—
Cables in connection with the lowering of Friday Hill.—Callender's Cable and Construction Co., Ltd.

Kingston-on-Thames.—Education Committee. Accepted:
Installing electric lighting in the Tiffin boys' school (£300).—Borough electrical engineer.

Lancaster.—Town Council. Accepted:—
Feeder switchgear.—Ferguson, Pailin & Co., Ltd.
Auxiliary plant for Caton Road works (£1,380); rotary converter (£1,080).—Metropolitan-Vickers Electrical Co., Ltd.

London.—HAMMERSMITH.—Electricity Committee.
Electric lighting installation at St. Mary's Church, Stamford Brook (£100).—Messrs. Penn & Co. (Recommended.)
Distribution boards and circuit breakers (standard type) (£258).—Park Royal Engineering Works, Ltd. (Recommended.)
Mild steel flooring for No. 2 engine room (£535).—Sanders & Foster, Ltd. (Recommended.)

Works, Cartage, and Cemetery Committee.
Four new batteries for electric vehicles (£197 each; total, £788; less £81 allowance for three old batteries).—Chloride Electrical Storage Co., Ltd.

ST. MARYLEBONE.—Electric Supply Committee.
Steel work for the new heavier-section crane track girders at the generating station, new staging for the transformers at Aybrook Street, and for lifting tackle at Rathbone Place sub-stations (£751).—Sanders and Foster, Ltd. (Recommended.)
Ash-handling plant for the West boiler house at the generating station (£2,925); ditto ditto for the East boiler house (£7,369).—Underfeed Stoker Co., Ltd. (Recommended.)
Twelve sets of 3-phase, e.h.p. equipment and for dismantling eight sets of existing 3-phase, e.h.p. equipment, and re-erection or supply of equivalent gear at the sub-stations, including the l.p., d.c. panels. Ironclad e.h.p. gear:—

Metropolitan-Vickers Electrical Co., Ltd.	£20,683
A. Reyrolle & Co., Ltd.	17,365
Bertram Thomas, Ltd.	14,715
Switchgear & Cowans, Ltd.	14,610
Ferguson, Pailin, Ltd. (Recommended.)	13,383

METROPOLITAN ASYLUMS BOARD.—Installation of electric lighting at North-Western Hospital:—

Electrical Contracting & Motor Co. (Recommended.) ...	£1,660
D. Henderson	1,679
Perfecto Electrical Co.	1,750
A. F. Goodwin & Co.	1,823
T. Clarke & Co., Ltd.	1,832
J. Briggs & Co.	1,836
Brightside Foundry & Engineering Co., Ltd.	2,087
G. H. Neal & Co., Ltd.	2,096
Buchanan & Curwen	2,245
G. E. Taylor & Co.	2,250
G. Hopkins & Sons (Clerkenwell), Ltd.	2,256
Grierson, Ltd.	2,291
A. Higginbotham & Sons	2,400
Higgs & Hill, Ltd.	2,570
A. Dean & Co., Ltd.	2,572
T. W. Heath, Ltd.	2,850
Gordon Herbert Electrical Co.	2,867
National Electric Construction Co., Ltd.	2,970
W. Warburton & Co., Ltd.	3,033
A. Hawkins & Sons	3,099
H. Hope & Sons, Ltd.	3,250
A. Cozens	3,666

Installation of electric lighting and power in laundry, Grove Hospital:—

T. Clarke & Co., Ltd. (Recommended.)	£150
Electrical Installations, Ltd.	163
Buchanan & Curwen	177
V. G. Middleton & Co., Ltd.	196
G. E. Taylor & Co.	199
Lund Bros. & Co.	215
Electrical Contracts & Maintenance Co., Ltd.	217
A. V. Gifkins & Co., Ltd.	229
Toy & Winslow	242

The following tenders were received for two electric motors for the laundry at Grove Hospital:—

Electric Construction Co., Ltd.	£178
J. H. Holmes & Co.	230
British Thomson-Houston Co., Ltd.	232
Ditto (alternative)	255
General Electric Co., Ltd.	233
Ditto (alternative)	238
Metropolitan-Vickers Electrical Co., Ltd.	260
English Electric Co., Ltd.	281

Manchester.—Electricity Committee. Accepted:—
L.p., d.c. switchgear for Dickinson Street sub-station.—Bertram Thomas.
Two 10-ton hand-operated overhead travelling cranes for Chorlton-upon-Medlock and Ancoats sub-stations.—Vaughan Crane Co., Ltd.
Cable.—British Insulated & Helsby Cables, Ltd.
L.p. pipework at Barton power station.—Dilworth & Carr, Ltd.
L.p. valves and cocks.—J. Blakeborough & Sons, Ltd.

Tramways Committee.
Two light-weight tramcar motors.—Metropolitan-Vickers Electrical Co., Ltd.
Tramway rail bonds.—British Insulated & Helsby Cables, Ltd.

New Zealand.—Auckland Harbour Board. Accepted:—
Seven 3-ton, five 5-ton electric quay cranes and two 3-ton and two 5-ton electric roof cranes for Prince's Wharf (£34,955) (without spare parts).—Richardson, McCabe & Co. (Stothert & Pitt, Ltd.). Eighteen tenders received.
Six mono-rail electric cranes (£440) (without spares), one 1-ton electric crane (£635) (without spares).—Bedford Engineering Co., Ltd.

Southland Electric Power Board. Accepted:—
66,000-V outdoor switchgear (£2,600).—A. D. Riley & Co., Ltd. (Ferguson, Pailin, Ltd.).—*Tenders.*

Reigate.—Town Council. Accepted:—
Static transformers (£379).—Hackbridge Electric Construction Co., Ltd.
H. and l.p. switchgear for sub-station (£1,174).—Switchgear & Cowans, Ltd.

Salford.—Health Committee. Accepted:—
Electrical installation at the Ladywell Sanatorium (£312).—Maitland and Co.

Electricity Committee. Accepted:—
3,500 yd. l.p. 3-core cable and 500 yd. l.p. concentric do. (£870).—W. T. Glover & Co., Ltd.

River Irwell Conservancy Committee.
Two electrically-driven centrifugal pumps (£607).—Mather & Platt, Ltd.
Two electrically-driven reciprocating pumps (£1,473).—Tangyes, Ltd.

Tramways Committee.
38 tons of steel rails (£11 10s. per ton).—Walter Scott, Ltd.
50 tons ditto (£12 8s. 4d. per ton).—Bolckow, Vaughan & Co., Ltd.
Steel crossing, switches, fishplates, &c. (£1,554).—Hadfields, Ltd.

Scunthorpe and Frodingham.—Urban Council. Accepted:
Electrical recorders, &c., for the new reservoir (£600).—Galpin, Hall & Co.

South Africa.—Messrs. C. A. Parsons & Co., Ltd., have received an order from the Victoria Falls Power Co., Ltd., for three 15,000-kW turbo-alternators and surface condensing plant, together with one spare alternator, for the Witbank generating station, South Africa.

FORTHCOMING EVENTS.

Electrical Power Engineers' Association (Kent Section).—Saturday, June 9th. At the Carlton Café, Tunbridge Wells. General meeting.

Institution of Railway Signal Engineers.—Wednesday, June 13th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 6.30 p.m. Paper on "Theory of Interlocking, with some Problems and Suggestions," by Mr. J. S. Moore.

Institute of Transport.—June 14th, 15th, and 16th. At the Cutlers' Hall, Sheffield. Annual Congress.

Royal Institution of Great Britain.—Friday, June 15th. At Albemarle Street, W. At 9 p.m. Lecture, "The Life History of an Alpha Particle from Radium," by Sir Ernest Rutherford, F.R.S. Saturday, June 16th. At 3 p.m. Lecture on "Atomic Projectiles and their Properties," by Sir Ernest Rutherford, F.R.S.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

WE have to remind readers that Service Department inquiries should be accompanied by a stamped addressed envelope.

The makers or suppliers of the following device are asked for:—

COLUMBUS time switch.

NOTES.

The National Joint Industrial Council for the Electrical Supply Industry.—Ald. W. Walker, M.I.E.E., M.I.Mech.E., of Manchester, has been re-elected chairman of the National Joint Council for the Electricity Supply Industry. He has been chairman since the formation of the Council in 1919, receiving the unanimous support of both employers and trade unionists on every occasion. Acknowledging the honour, Alderman Walker said that he greatly appreciated the renewed mark of their confidence, especially as it had been a unanimous decision of both sides of the Council. He hoped the year would be a prosperous one. Their industry was one of the most reliable of trade barometers, as the consumption of electricity for power purposes indicated the work being done in any particular industry. He had seen many returns from

typical undertakings throughout the country, and they showed that there was a distinct improvement in trade. It had not been rapid, but it was general and it was persistent. As the use of electricity for power became almost universal, their statistics, which were so accurately compiled, would be increasingly valuable as a method of rapidly ascertaining the variations in the conditions of particular industries and districts.

Alderman Walker is a director of Messrs. Henry Simon, Ltd., engineers, Manchester, and other companies.

Appointments Vacant.—Assistant for test room, for the Wimbledon Corporation electricity department; assistant engineers (£480), for the Government of Nigeria Posts and Telegraph Department; assistant draughtsman (£312), for the Newport (Mon.) Corporation electricity department; chief lecturer in electrical engineering, for the Leeds Technical School; shift charge engineers, for the Kirkcaldy Corporation electricity department. (See our advertisement pages to-day.)

Microphonic Flames.—A few weeks ago it was reported in the daily Press that Dr. Lee de Forest had used a flame for the direct production of telephonic currents by sound waves. In response to a request from the Editor of *Nature* for details of his device, Dr. de Forest writes as follows (*Nature*, June 2nd, 1923):—

"I have as yet prepared no paper on the subject of the 'microphonic flame.' For a long time I had puzzled over the problem of turning sound waves *directly* into electric telephonic currents. I recognised that sound waves passed through flames in the air; also that a flame was, to a certain degree, conducting electrically. Hence I reasoned that if one passed a current through a flame, its conductivity *must* vary, more or less, with the alternate waves of compression and rarefaction, which constitute sound.

"Setting out to verify my deductions, I succeeded almost at once. I employed first a 'bat's-wing' gas-flame, enriched this with potassium salts, used two platinum wire electrodes across a dry cell battery of 100 to 200 volts, in series with a high-resistance (radio) telephone receiver. By carefully adjusting the electrodes in the flame (especially the *cathode*—the position of the anode is not important; it can even be located a short distance *outside* the flame) I obtained in the telephone receiver a faint but *very perfect* reproduction of the music of a gramophone played 3 ft. from the flame. The adjustment of the gas pressure, using this type of flame, is critical. If too strong the flame roars in the telephone receiver. If too low, the conductivity and sensitiveness of the flame falls off.

"I next employed a type of Welsbach burner and mantle, using as electrodes platinum gauze 'imbedded' in the mantle and directly inside the mantle. Also an oxy-acetylene flame, employing for electrodes platinum wire *encased* in quartz, which, of course, becomes conducting in this flame. This arrangement gives an exceedingly perfect reproduction of the sound—voice or music—far better than any carbon microphone.

"A small alcohol burner and flame can be employed. In this case I recommend as cathode a Nernst glower as supplying the necessary electrons. Or enrich the blue flame by potassium or sodium salts fed up through the wick, with the alcohol.

"Audion amplifiers must, of course, be employed if one wishes to use the 'flame microphone' for broadcasting, radio-phone, or "phonofilm" purposes. The sensitiveness increases in general with the impressed p.d. across the electrodes—up to a limit.

"Great care must be taken to guard against: (1) hissing due to too high voltage discharge; (2) flame noises; (3) air fluctuations; (4) depositing of carbon upon the electrodes.

"I have not had time yet to make a careful scientific study of this phenomenon, but am persuaded it is chiefly a *pressure* effect, controlling ionisation and the ionised conductivity of the flame."

Inquest.—An inquest was held at Blackburn on May 29th relative to the death of Mr. Thomas Wallwork, Corporation mains superintendent, who died from shock following contact with a cable carrying current at 7,000 V. The evidence of Mr. A. F. Gillis, electrical engineer, showed that he, along with the deceased and another engineer, was called out on the evening of May 9th to locate a fault. It was eventually traced to a sub-station off Park Road, and whilst here deceased raised the safety shutters, and, after placing a rubber glove on his hand, began to examine the busbars, which were dead, though the current had not been switched off from the main station. Suddenly he came in contact with the main cable, and witness and his colleague were unable to render assistance. Witness added that within three minutes they had got into communication with the Jubilee Street station by telephone, and the main current had been switched off. Witness said Mr. Wallwork was an extremely careful man, particularly with regard to the safety of his workmen. His right arm was burnt away, and he was burnt about the leg and head. A verdict of "Accidental death" was returned, and the counsel for the Electrical Power Engineers' Association supported a resolution of sympathy passed by the jury.

The Utilisation of Solar Heat.—In *Le Génie Civil* of April 7th M. P. Caufourier reviews the attempts that have been made to use the sun's radiation for the generation of steam. The first practical system was that devised by Shuman, of which we gave a description in 1914 in connection with an installation put down in Egypt; in this case steam was generated at a temperature above 100 deg. C., necessitating the use of apparatus having a small water content, and therefore practically no reserve of heat energy—even a cloud passing over the sun produced an immediate effect throughout the plant. M. Berland, chief of the hydrological station of Touggourt, Algeria, has sought to avoid this inconvenience by using water only, in the liquid state, below 100 deg. C., the subsequent evaporation taking place below atmospheric pressure in auto-evaporators devised by M. Caufourier, which operate on a very simple principle: hot water from the solar heater is passed through an intermediate tank to the evaporator, in which the pressure is maintained below that corresponding to the vapour tension of the water; consequently evaporation takes place and the steam is used to drive a turbine, passing into a condenser. The heat of evaporation is derived from the water passing through the evaporator, which falls in temperature, and must be removed by a pump, which returns it to the solar heater. The condensate is also returned to the heater. This system ensures a regular circulation of water, better absorption of heat, because no steam is present in the pipes, and greater regularity of operation owing to the use of the intermediate "buffer" storage tank. A superheater is provided, to dry the steam and increase the efficiency of operation; this is the only part of the apparatus which requires fuel, and it gives a superheat of from 35 to 40 deg. C. The engine should be preferably a steam turbine.

In South Algeria the average working period will be 10 hours a day for 330 days in the year. It is proposed to adopt this system for irrigation, the water pumped serving as cooling water for the condenser. In other cases cooling water would be stored in shallow tanks, and would be cooled by evaporation and radiation during the night.

In the oasis of Touggourt, which has a population of 12,000 inhabitants and a plantation of 350,000 palm trees, irrigation water for 60 years has been derived from artesian wells, but the water level has fallen and pumping is necessary, for which purpose 210,000 kWh per annum is required. M. Berland proposes to install a solar heat plant having a mirror surface of 2,400 m², giving 100 kW, the annual output being 300,000 kWh; in addition to the pumping load above mentioned, lighting, power, and ice-making installations would be served. The initial cost is estimated at 600,000 fr., of which 150,000 fr. would be spent on the solar heat receivers. The annual cost, including depreciation, is estimated at 137,000 fr., and the receipts at 252,000 fr. The amortisation of the distributing network is not allowed for in this estimate.

M. Caufourier expresses the hope that the project will be carried out, as its success would be of great importance to the French possessions in Africa.

Electricity in Coal Mining.—In a lecture upon "Recent Electrical Developments in Coal Mining," at the Mining Exhibition on June 4th, Professor Douglas Hay, of Sheffield University, compared electricity with compressed air, which, he said, was electricity's only serious rival. For many purposes compressed air equalled or surpassed electricity, but its overall efficiency was lower. He estimated that the efficiency of electricity from generator to motor was 60 per cent., while that of compressed air was generally in the neighbourhood of 15 per cent., and frequently lower. The two systems were admirably combined in the electrically-driven air compressor, and from this point of view they might be considered as being of mutual service rather than as rivals. In gassy mines it appeared advisable to use compressed air at the coal face, but he was not one of those who believed that it was impossible to construct electrical apparatus which could safely be used in inflammable atmospheres. The limits and conditions of the propagation of flame in mixtures of fire-damp and air, and coal-dust and air were being defined by careful research, and once these limits were settled it would certainly be possible to design apparatus to meet these conditions.

Engineer Stores in the Great War.—Through the courtesy of the Dean of the Faculty (Dr. Wertheimer, B.A., D.Sc., F.I.C.) two lectures were recently delivered to the Engineer Students at the Merchant Venturers' Technical College, Bristol, by Col. S. L. Cra'ster, C.B., C.I.E. (late Chief Mechanical Engineer, War Office), on the supply of engineer stores, during the Great War, to the British and American Armies in the Field, and for Home and Colonial defence. From the first it was clear that the leisurely peace-time procedure of supply was unsuitable, and by empowering the Director of Fortifications and Works (D.F.W.) to place all contracts direct, "red tape" was eliminated. The Director (after about a year's trial) delegated his powers to Capt. (now Lt.-Col.) R. Oakes, R.E., one of his staff captains, officially known as "Inspector of Iron Structures" (I.I.S.). Capt. Oakes discussed demands with manufacturers on the telephone, decided what would be suitable, and placed his orders there and then, following them up in writing, having obtained the Director's concurrence. He also kept the Director of Army Contracts and the Finance Branches of the War Office informed of all action taken. Capt. Oakes's guiding principles were: (1) Rapidity of supply, (2) economy in price, (3) efficiency of inspection, (4) economy in cost of administration.

The new organisation which Col. Oakes had created had been working five months, when he was selected to occupy

an important railway post in Mesopotamia, and the lecturer succeeded him at Adastral House as Chief Mechanical Engineer. When the Armistice was signed, the headquarters of "F.W.8" at Adastral House numbered 49 officers and 143 clerks and draftsmen, as compared with a total strength of 29 of all ranks on the first day of the war. The average monthly expenditure during 1918 was £1,242,000, and the total from August, 1914, to March, 1919, was £32,250,000. The cost of administration, on the other hand, worked out to less than 0.66d. per pound sterling of stores delivered, and Col. Cra'ster claimed that economy of administration in F.W.8 was fully proved, and voiced the acknowledgment of the Corps of Royal Engineers and the Army to their civilian brother engineers who had borne their full share in attaining victory.

The Finance Branch settled over 16,000 bills after the Armistice totalling £4,800,000, approximately, and the staff of F.W.8 had dwindled to nine officers and 14 other ranks by December, 1919, being finally extinguished by March 31st, 1921.

Major-General Sir G. K. Scott-Moncrieff, K.C.B., K.C.M.G., C.I.E. (Director of Fortifications and Works, War Office, in 1914 and until March 31st, 1918), and Major-General Sir W. A. Liddell, K.C.M.G., C.B. (the present D.F.W.), attended the lectures, and gave short addresses.

A Lightning Photograph.—The accompanying illustration is reproduced from a photograph taken recently by a resident of Bridlington, and forwarded to us by Mr. A. J. Beckett, M.I.E.E., borough electrical engineer. In the original print the striation of the brightest part of the flash is remarkably clear, and shows a tendency to rotate after the manner of the strands of a cable. The dark patch appears to be due to defective development, but for the bright patch we have no explanation.

Inquiries which we have made of Mr. Beckett show that the camera was at a bedroom window, overlooking a forecourt and buildings, from which no light could emanate that would produce such effects as those seen in the figure. He regards it as quite impossible that they should be due to any other cause than lightning.

Artificial Lightning.—In order to study the effects of lightning on electrical transmission lines and apparatus it is necessary to reproduce the conditions in the laboratory. Mr. F. W. Peek, junr., of the General Electric Co., U.S.A., gives in the *Electrical World* of May 19th some particulars of a "lightning generator" used for this purpose. Very few lightning discharges on transmission lines take place over gaps set for 400,000 volts or more, and insulator strings of seven or eight units rarely flash over. A 200-kV generator was built a few years ago, and has now been developed to give approximately two million volts; it consists of a large condenser which is charged to the desired voltage and discharged through a known inductance and resistance, the result being a single lightning impulse of great power, which is accompanied by a loud report. The power may be of the order of millions of kilowatts, and the current 10,000 amperes, lasting for less than a millionth of a second.

A Novel Electric Sign.—A short time ago considerable interest was aroused by the appearance of a novel type of sign at the Elephant and Castle. To the spectator it appeared as though letters of light travelled from right to left across the face of the sign, spelling out messages continuously in the manner of the tape machine. Since the advent of this sign two others have been erected in London. The latest is the *Daily Express* "news bulletin," which is mounted upon the side of one of the buildings surrounding Trafalgar Square, and at the close of the day this flashes out a continuous stream of news items telephoned from the journal's Fleet Street offices. All these signs are the work of the Scintillating Sign Co., from which we recently received permission to examine the working of the sign in Trafalgar Square.

The sign itself is about 45 ft. long and 3 ft. in height, and contains about 1,400 lamps in nine rows, each lamp having a consumption of 20 W. The lamps are contained in deep conical reflectors, which completely separate the light of each lamp from that of its neighbours. From these lamps wires of 1/22 gauge are brought to a contact board measuring only about a foot in length and 1¼ in. in width; there are thus about 100 of these contacts to the square inch, and each contact is made by an insulated spring plunger, the top of which just projects above the face of the board. The contacts are operated by the pressure of metal blocks, upon the face of which are embossed alphabetical and numerical characters. It will be seen that owing to the closeness of the contacts the pressure of one of these metal characters causes the depression of a number of contacts corresponding to the configuration of the letter or figure transmitting the result to the lamps in the sign connected to the contacts. Extraordinary care had to be exercised in ensuring that the positions of the contacts were in the same relationship as the lamps controlled by them. The pressure is maintained by brass top-plates, between which is a slot. The metal blocks are attached in the form of words and numbers to a chain and the latter pulls them over the face of the contact board. A number of pulleys are employed and the chain passes over these, the whole system being kept in motion by a 1-h.p. motor. The wires are made up in dry-core cables similar to telephone cables, and where they are brought up to the contacts they are simply insulated with "Empire" tubing. A most striking feature of the installation is the compactness and neatness of the wiring, which at the contact board naturally has to be packed into a very small space. The cables are of the India Rubber, Gutta Percha & Telegraph Works Co.'s manufacture, and the wiring was carried out by the Scintillating Sign Co. We are informed that the company is erecting another sign in London, and that it has also received orders from Paris and Gothenburg, among other places.

Accident.—Whilst repairing overhead wires at Padiham, on May 29th, Charles Bury, a Burnley Corporation tramway employé, fell 16 ft. from the electric trolley, and was seriously injured.

Birmingham Electric Club.—This year's summer visit of the Club is to take the form of an inspection of the works of the British Thomson-Houston Co., Ltd., at Rugby, on June 20th.

A Belfast Appointment.—At a meeting of the Belfast Electricity Committee, when Mr. Henderson raised a point concerning an appointment, which he alleged had been given to an Englishman, Alderman Jameson pointed out that the appointment was made on merit. Although the man had come from England, he was really Irish, and was born in Ballymoney.

The Leeds Tramway Accident.—On May 31st, Col. Mount, R.E., resumed his inquiry into the circumstances of the serious accident which occurred at Churwell Hill, Leeds, on May 12th. The principal witness was the driver of the car, who had recovered sufficiently to give evidence. He stated that he became a motorman in 1915. In 1917 he joined the Army, and was wounded in the left forearm and gassed. He returned to the Leeds tramways, and was again passed as a driver in 1921. In reply to questions by the Inspector, he said that his left arm had been left weak, and also that his nerves had been affected by the gas. On the morning of the accident he found all the brakes in order, and just before the accident happened they acted perfectly. When descending the hill after the last stop he did not apply power, but released the hand-brake. The car proceeded a few yards, and then gave a sudden jump.

At this point the Inspector decided that the remainder of the driver's evidence should be heard *in camera*.

INSTITUTION NOTES.

Association of Consulting Engineers.—The Committee's Report for the year ended April 30th last records the election of five new members, the death of Mr. Sidney Sharp, and the resignation of two members, making the total membership 86. In July last the Association's Standard General Conditions of Contract for use in connection with electrical and mechanical engineering contracts were

finally approved and published. The use of these Conditions simplifies the work of both the engineer and the contractor. The sub-committee appointed to draw up standard general conditions for export orders produced a draft which was approved by the main committee in March last and circulated to members. After consideration of communications received from the Swedish Association of Consulting Engineers regarding participation in the proposed International Federation of Consulting Engineers, it was decided to take no action in the matter. A satisfactory arrangement had been concluded with the Cable Makers' Association to ensure that the prices quoted to members of the Association compared favourably with quotations to foreign customers. The annual dinner was held at St. Stephen's Club on December 6th, 1922, when 110 members and guests were present. During the year the Committee corresponded with the Law Society regarding the attempted evasion of the payment of expert witnesses' fees, and secured the promise that individual cases would be dealt with if notified to the President of the Law Society as they arose. Messrs. H. R. J. Burstall and A. H. Dykes were appointed to serve on the Electrical Contractors' Registration Authority, established by the Institution of Electrical Engineers. On two occasions a deputation from the Associated Municipal Electrical Engineers had met the Committee and all points raised were satisfactorily settled. The Committee had represented to the British Engineering Standards Association that the preparation by the B.E.S.A. of a complete purchasing specification was beyond its province, and would not be to the advantage of the industry as a whole. The subject was receiving the attention of the B.E.S.A. The report gives a list of the Association's representatives on the various B.E.B.A. panels and other committees.

The annual meeting of the Association was held on May 28th. The President, Mr. A. M. Sillar, M.Inst.C.E., who presided, expressed disappointment that the increase of membership had not been greater, but thought that the Association was being appreciated more and more by the organisations with which it came into contact. He said that the rules relating to the payment of expert witnesses' fees required alteration, and this applied as well to certain other parts of the rules in which the wording was rather vague—particularly those relating to what a consulting engineer might or might not do. Mr. Sillar made special mention of the work of the hon. secretary (Mr. Dykes) and the hon. treasurer (Mr. Lowcock). The following new members of Committee were elected: Messrs. J. Angus, W. G. Gedye, O.B.E., W. Doig Gibb, O.B.E., and E. W. Monkhouse, for London members; and for country members Messrs. J. H. Blizard (Southampton), and C. J. Lomax (Manchester).

Institution of Electrical Engineers.—SOUTH MIDLAND CENTRE.—About 150 members took part in a highly-successful summer visit to the Cannock Chase Collieries to inspect the electrification work on May 30th. The visit was made possible through the courtesy of Mr. S. F. Sopwith, general manager of the Cannock Chase Colliery Co., and the good offices of Mr. C. Jones, M.I.E.E., the meeting-place being No. 9 Pit at Old Hednesford. The visitors descended the mine and inspected the working faces, where hand and machine mining was witnessed, together with underground haulage gear, sub-stations, &c.; afterwards the members were shown the screening operations of coal and then proceeded to the Colliery Co.'s electric power station at Chase Terrace, where luncheon was served, Mr. Sopwith being the host. An opportunity was given of seeing the company's copper and aluminium overhead lines and cables, and, in the Anglesey Basin, of mineral being hauled direct from the coal face to the canal, while *en route* a portion of the new venture of the company, *viz.*, a village lighting scheme employing overhead mains, was noticed. On the way home a small village lighting sub-station and e.h.p. lines recently erected to supply Brownhills were inspected, the party arriving back in Birmingham about 4.30 p.m.

A.M.I.E.E. EXAMINATION RESULTS.—The results of the April examination of candidates for Associate Membership have been published. The list of those who were successful includes 43 officers of the Royal Engineers. Of the non-service candidates 42 passed both parts, four passed Part I only, and ten passed Part II only. The results of examinations held at places abroad will be announced later.

South African Institution of Engineers.—The Council of the Institution has appointed a sub-committee to go into the question of participation in the South African Section of the British Empire Exhibition. It is also proposed to arrange the reading of technical papers dealing with South African engineering, and to prepare a résumé setting forth the activities of the Institution for inclusion in a pamphlet giving particulars of the various scientific and technical societies of South Africa which it is proposed to issue at the Exhibition.

Institute of Transport.—The Council has decided that the 1924 Congress of the Institute shall be held at Bristol, and for this reason an invitation to take entire responsibility for organising the Transport Section of the World Power Conference, proposed to be held in connection with the British Empire Exhibition, 1924, has been declined.

Institution of Civil Engineers.—The annual conversazione of the Institution will take place on Thursday, July 12th, at the Institution at 8 p.m.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Birthday Honours.—In the list of the King's Birthday Honours we note the name of "William McClelland, Esq., O.B.E., M.I.E.E.," who becomes a C.B. (Civil Division); also that of "John Henry Butters, Esq., M.B.E., chief engineer and general manager of the Hydro-Electric Department, State of Tasmania," who is appointed to be a C.M.G. "Holberry Mensforth, Esq., C.B.E., M.Sc. (Tech.), M.I.M.E., Director-General of Factories," is made a K.C.B. (Civil Division). "Rayner Childe Barker, Esq., C.I.E., Director-in-Chief, Indo-European Telegraph Department, India Office," receives the honour of knighthood. We offer our congratulations to all of these well-known gentlemen.

The *Financial Times* states that Mr. EDWARD WILSHAW, the recently-appointed secretary of the Eastern Telegraph Co., Ltd., has been elected Chairman of the City Branch of the Royal Society of St. George.

The Managers of the Royal Institution have appointed Sir WILLIAM BRAGG, F.R.S., Fullerian Professor of Chemistry, Director of the Laboratory, Superintendent of the House, and Director of the Davy-Faraday Research Laboratory.

Science states that Dr. GEORGE K. BURGESS has been appointed Director of the United States Bureau of Standards to succeed Dr. S. W. Stratton, who resigned to take up the presidency of the Massachusetts Institute of Technology. Dr. Burgess has been connected with the Bureau for 20 years, and was appointed chief of the metallurgical division in 1913.

Leek Urban Council has increased the salary of the electrical engineer, Mr. H. TULLOCH, from £450 to £500 per annum, and that of his assistant, Mr. JOHNSON, from £300 to £325.

The Apex Electrical Distributing Co., of Cleveland, U.S.A., makers of household appliances, has appointed Mr. A. L. ZOLLNER as European sales representative, and he is about to establish his headquarters in London.

Maidstone Town Council has fixed the salary of Mr. LAMBERT, manager of the light railway, at £600 per annum, with no bonus, and inclusive of other emoluments. The salary is to come up for revision in three years.

At the annual meeting of the British Engineers' Association (Inc.), held at the Hotel Victoria, London, on 31st ult., Mr. E. W. PETTER, chairman of Messrs. Petters, Ltd., and managing director of Messrs. Vickers-Petters, Ltd., was unanimously elected president of the Association in succession to Mr. Neville G. Gwynne, C.B.E., who had occupied that position for the past two years. The meeting heartily thanked the retiring president. Mr. H. J. WARD, of Messrs. J. and E. Hall, Dartford, was elected chairman of the Executive Committee in the place of Mr. Petter. The following new members were elected to the Council:—Engineer Vice-Admiral Sir George Goodwin, K.C.B. (Messrs. Richardsons, Westgarth and Co., Ltd.); Lt.-Col. W. C. Symon (Messrs. Vickers, Ltd.); Mr. David C. Lycett Green (Messrs. E. Green & Son, Ltd.); and Mr. Wilfred Lancaster (Messrs. Hughes & Lancaster, Ltd.).

Lieut.-Colonel R. R. GREENE, who has recently retired after 22 years as manager of the Wallasey Corporation tramways, has been presented with a silver salver, and Mrs. Greene with a gold watch, by the staff.

Our contemporary the *Commonwealth Engineer* reports that Mr. H. KINGDON-ROWE, manager and engineer to the Parramatta Electric Supply Co., Ltd., N.S.W., has been appointed engineer-manager to the Rockhampton, Q'ld, municipal electricity supply department. Mr. A. CAMERON, chairman of the Melbourne Metropolitan Tramways Board, who is on a visit abroad to investigate the latest methods of electric tramway operations, left for San Francisco in March. He is expected to reach London in June. Then he will go to the Continent, and will return to Melbourne about the end of the year. Mr. R. H. BARTLEY, who has been appointed assistant engineer to the Auckland electric power board, has resigned from the position of electrical engineer and tramways manager to the New Plymouth borough council.

Mr. T. Y. PORTER, A.M.I.E.E., manager of the engineering department of Messrs. Graham Rowe & Co., Lima, Peru, South America, has recently arrived in England on four months' holiday. During his stay in this country his address will be 6, Lyndhurst Square, Peckham, London, S.E.15.

Obituary.—Mr. F. S. C. PHILLIPS.—We regret to learn from Messrs. A. V. & R. O. Willmott that their partner, Mr. F. S. C. Phillips, died on May 27th. The business will be carried on by the two remaining partners.

Mr. W. F. MORRIS.—The death is announced of Mr. William Fisher Morris, who was for a number of years foreman electrician to the Pearson & Knowles Coal and Iron Co., Ltd., Warrington. He was 63 years of age, and was educated at Beccles College, on leaving which he served his apprenticeship as an electrician with Davey, Paxman & Co., Ltd., London. He was afterwards in the employment of the Westinghouse Co. at Manchester, and in 1911 he took up his position with the Pearson & Knowles Co.

Will.—The late Mr. SYDNEY GEDGE, of W. T. Henley's Telegraph Works Co., Ltd., left £18,450.

NEW COMPANIES REGISTERED.

C. J. Ferguson & Sons, Ltd. (190,308).—Private company. Registered May 30th. Capital, £5,000 in £1 shares (2,500 7 per cent. cumulative preferred and 2,500 ordinary). To take over the business of an electrical engineer, founder, metal worker, manufacturer and broker of, agent for, and dealer in electrical dynamos and apparatus, internal-combustion engines, agricultural implements, and other machinery carried on by C. J. Ferguson in London as "C. J. Ferguson & Sons," and all or any of the assets and liabilities connected therewith. The first directors are:—C. W. Ferguson, 237, Essex Road, N.1, electrical engineer; A. Ferguson, 235, Essex Road, N.1, electrical engineer; C. J. Ferguson (chairman), no address given. Qualification, 1 share. Remuneration, £100 each per annum. Solicitors: Bruce, Miller & Co., 28a, Basinghall Street, E.C.

Sutherlands (Electrical Engineers), Ltd. (190,210).—Private company. Registered May 25th. Capital, £5,000 in £1 shares. To acquire the business of electrical engineers now carried on by Sutherland and Co., at Trinity Street, Bolton, and Ainsworth Road, Radcliffe. The permanent directors are:—R. Walker, 33, Albert Road, Bolton, mechanical engineer; J. Whittaker, "Kenmore," Whitefield, mechanical engineer; J. Berry, 28, Turk's Road, Radcliffe, mechanical engineer. Qualification, £200. Secretary: G. O. Neil. Solicitor: H. St. J. Dutton, 19, Acresfield, Bolton.

H. N. Shorrock (Morecambe), Ltd. (190,332).—Private company. Registered May 31st. Capital, £2,000 in £1 shares. To acquire the business of an electrical engineer and contractor now carried on at Morecambe and Heysham, Lancs., as "H. N. Shorrock." The first directors are:—H. N. Shorrock, 73, Marine Parade, Sandylands, Morecambe; B. Durrans, 10, Lake Road, Morecambe. Qualification, 100 shares. Solicitor: N. J. Clough, Bank Chambers, Lancashire Street, Morecambe.

T. B. & J. A. Mathieson, Ltd. (12,702).—Private company. Registered in Edinburgh May 24th. Capital, £1,000 in £1 shares. To acquire the business of T. B. & J. A. Mathieson, mechanical and electrical engineers, armature winders, agents and dealers in electrical accessories, of 114, Trongate, Glasgow. The first directors are:—T. B. Mathieson, 17, Tummel Street, Kiddrie, Glasgow, electrical engineer; J. A. Mathieson, 196, Langside Road, Crosshill, Glasgow, electrical engineer. Qualification, 50 shares. Registered office, 114, Trongate, Glasgow.

British Aerial Engineering Manufacturers, Ltd. (190,306).—Private company. Registered May 30th. Capital, £1,000 in £1 shares. To acquire and exploit the patents now held by G. R. Steward, and to carry on the business indicated by the title. The first directors are:—G. R. Steward, Buccleuch House, 18a, Valkyrie Road, Westcliff-on-Sea; Mrs. L. Steward, Buccleuch House, 18a, Valkyrie Road, Westcliff-on-Sea. The said G. R. Steward shall be managing director for 10 years at a commencing salary of £500 per annum. Registered office: 25 and 26, Lime Street, E.C.3.

Northern Light and Power Co., Ltd. (N.I. 87).—Private company. Registered in Belfast May 22nd. Capital, £2,000 in £1 shares. To carry on at Kilkeel and district the business of an electric light company. The subscribers (each with 1 share) are:—R. H. Hamilton, Electric Station, Kilkeel, Co. Down; J. A. Shannon, Newcastle, Co. Down, engineer; M. Walker, Newcastle, Co. Down, engineer. The first directors are not named. Registered office: Kilkeel, Co. Down.

Waterloo Electric Co., Ltd. (190,299).—Private company. Registered May 29th. Capital, £1,000 in 750 10 per cent. participating preference shares of £1 each and £5,000 deferred shares of 1s. each. To carry on the business of manufacturers, suppliers, and/or erectors of all kinds of apparatus for transmitting, communicating, or receiving music, speeches, or messages by wireless telegraphy and telephony, &c. The subscribers (each with one participating preference share) are:—H. Evans, 41, Beresford Street, Camberwell, S.E.5, electrical engineer; A. King, 34, Surrey Street, Strand, W.C.2, accountant. The first directors are:—Emily L. Evans and H. Evans (both permanent) and others to be appointed by the subscribers. Qualification, 100 shares. Remuneration, £100 each per annum. Registered office: 129, Waterloo Road, S.E.1.

Ellesmere Port Electrical Co., Ltd. (190,329).—Private company. Registered May 31st. Capital, £500 in £1 shares. To take over the business of an electrical and general engineer and contractor carried on by G. Hodder at Ellesmere Port. The first directors are:—G. Hodder, 24, Whitby Road, Ellesmere Port; E. B. J. Gould, Cromwell Road, Ellesmere Port. Registered office: 24, Whitby Road, Ellesmere Port.

A. E. Acton-Burnell, Ltd. (190,220).—Registered as a private company on May 26th with a nominal capital of £2,500 in 2,486 preference shares of £1 and 1,680 preferred ordinary and 1,080 deferred ordinary shares of 1d. each. Objects:—To carry on the business of importers, exporters, and manufacturers of and wholesale and retail dealers in electrical apparatus and devices, terra cotta, plaster, china, porcelain, glass, hardware, leather goods, musical instruments, plated goods, perfumery, soap, furniture, ironmongery and turnery, shippers, agents, &c. The subscribers (each with one preference share) are:—W. Alexander, 15, Devonshire Road, Palmer's Green, N.13, clerk; G. Foster, 95a, North View Road, N.8, clerk. The first directors are not named. The holders of the preference shares are not entitled to any dividend, but in a winding-up they take priority over all other shares for return of capital. They have no further right to participate in profits or assets. Every original holder of at least 200 preference shares may appoint himself or any other person to be a director. The preferred ordinary shares confer the right to a fixed cumulative dividend of 240 per cent. per annum, and rank, as regards capital, next to the preference shares. The deferred ordinary shares are entitled to the whole of the surplus profits which are distributed in each year, and, in a winding-up, to the whole of the surplus assets remaining after paying off all the paid-up capital. Solicitors: Hicks, Arnold & Bender, 25, Southampton Street, Strand, W.C. No notice of situation of registered office was filed at time of incorporation.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Para Electric Railways and Lighting Co., Ltd. (85,368).—Return dated April 9th, 1923. Capital, £780,000 in 300,000 preference and 300,000 ordinary shares of £1 each. 325,000 preference and 300,000 ordinary shares taken up. £25,040 paid on 25,000 preference and 40 ordinary shares. £689,960 considered as paid on 300,000 preference and 389,960 ordinary shares. Mortgages and charges, £599,368.

Bury Electrical Plant Co., Ltd.—Satisfaction in full on May 14th, 1923, of mortgage dated July 10th, 1919, securing all moneys due or to become due from company to London Joint City and Midland Bank, Ltd.

Radio Phonopore and Electricals, Ltd.—Particulars filed on April 14th, of £3,000 debentures authorised January 22nd, 1923, charged on the company's property, present and future, including uncalled capital, the whole amount being now issued.

Leamington and Warwick Electrical Co., Ltd. (13,780).—Return dated March 9th, 1923. Capital, £100,000 in 2,500 preference and 7,500 ordinary shares of £10 each. 900 preference and 6,800 ordinary shares taken up. £76,000 paid. Mortgages and charges, £35,000.

Ruthen Electric Supply Co., Ltd. (138,021).—Return dated May 9th, 1923. Capital, £5,000 in 400 cumulative preference shares of £5 each and 1,000 preferred ordinary and 2,000 ordinary shares of £1 each. 175 cumulative preference, 875 preferred ordinary, and 1,449 ordinary shares taken up. £3,154 paid. Mortgages and charges, nil.

London Electric Wire Co. & Smiths, Ltd. (101,353).—Return dated April 30th, 1923. Capital, £1,250,000 in 750,000 ordinary and 500,000 preference shares of £1 each. 644,070 ordinary and 400,000 preference shares taken up. £350,035 paid on 35 ordinary and 350,000 preference shares. £694,035 considered as paid on 644,035 ordinary and 50,000 preference shares. Mortgages and charges, nil.

British Mica Co., Ltd. (72,187).—Return dated May 10th, 1923. Capital, £5,000 in 2,000 preference and 3,000 ordinary shares of £1 each. 785 preference and 2,194 ordinary shares taken up. £979 paid on 785 preference and 194 ordinary. £2,000 considered as paid on 2,000 ordinary shares. Mortgages and charges, £2,000 debentures and £650 mortgage.

St. James' and Pall Mall Electric Light Co., Ltd. (26,015c).—Return dated March 13th, 1923. Capital, £300,000 in 40,000 ordinary and 20,000 preference shares of £5 each. All shares taken up. £298,250 paid on 39,650 ordinary and 20,000 preference shares. £1,750 considered as paid on 300 shares. Mortgages and charges, £150,000 5½ per cent. debenture stock.

County of Durham Electrical Power Distribution Co., Ltd. (61,591).—Return dated April 5th, 1923. Capital, £425,000 in £1 shares. All shares taken up. £425,000 paid. Mortgages and charges, £250,000.

British Insulated & Helsby Cables, Ltd. (52,285).—Return dated April 5th, 1923. Capital, £2,000,000 in 500,000 preference, 1,000,000 ordinary, and 500,000 unissued shares of £1 each. 500,000 preference and 1,000,000 ordinary shares taken up. £1,072,675 paid on 372,350 preference and 700,325 ordinary shares. £427,325 considered as paid on 127,650 preference and 299,675 ordinary shares. Mortgages and charges, £700,000.

CITY NOTES.

Shanghai Electric Construction Co., Ltd.

Sir Alfred Dent, K.C.M.G., presided at the annual meeting on May 30th, and in announcing the final dividend of 8 per cent. (making 20 per cent. for the year), and the increased carry-forward, said that the profit-earning capacity of the company had been seriously affected by the depreciation on the subsidiary coinage, which rose to £139,757. The long negotiations with the municipality regarding railless traction were nearing their conclusion. A satisfactory feature of these was that the Council had agreed to undertake the reconstruction of the roads for railless traction, and their maintenance thereafter. The company would in this way be free from a great deal of capital expenditure, but would pay two Mexican cents per car mile for the use of the roads. The capital expenditure would thus be limited to the provision of the overhead equipment, rolling stock, and car accommodation.

Referring to the formation of the new Singapore company, the chairman said that by guaranteeing the debenture stock and undertaking, the Shanghai company's shareholders would mutually benefit with those of the new company, without the employment of any of the former's cash resources.

At a subsequent extraordinary meeting the division of each of the company's £10 shares into ten shares of £1 was approved.

Anglo-Portuguese Telephone Co., Ltd.

Viscount St. Davids presided at the annual meeting on June 1st, and in presenting the report and accounts, pointed out an error in the report (which was reviewed in our last issue). The statement of the effect upon the revenue of increased rates should have read: "Of the total revenue accruing for the year 1923, only 18 per cent. is due to the increase of rates authorised on April 1st, 1923. The proportion of the increase applicable to 1923 is approximately 31 per cent., the proportion for 1924 is approximately 67 per cent., while the balance of about 2 per cent. is not realised until 1925." The chief item for comment in the balance sheet was the writing-off of £55,689, consisting principally of the exchange adjustment figure of £54,619 which was shown as a credit balance in 1921, and was written off capital expenditure after consultation with the auditors. Capital expenditure had been greatly reduced, and the total amount of £48,492 represented (after writing off £9,870 to depreciation of stores) the expense of adding 1,673 stations to the exchanges at a cost of £23 each. A revaluation of stock, in escudos, had resulted, owing to a fall in exchange, in an appreciation of £15,831 in sterling. It was decided to write off to capital account £2,488 and to place £13,343 to an exchange adjustment account which could be utilised in the event of a rise in the escudo which would cause a proportionate fall in the sterling value of the company's stores. Although there had been a net loss of £16,201, owing to the fall in the value of the escudo, it was hoped that the effect of the increased rates would be to wipe out this loss entirely, provided the exchange did not depreciate further. The effect of the fall in exchange was emphasised by the fact that subscriptions were paid in advance, and therefore increased rates could not be made retrospective. The Government had helped them considerably, and increases had been allowed each year from 1918. They had been unable to pay dividends for two years, and future results depended entirely upon the exchange. If it

remained stable, the 1922 loss should be wiped out, and it should be possible to declare a dividend in 1924. Much Portuguese capital had been invested abroad, but immediately the exchange took a turn for the better, this capital would return and cause a speedy improvement in the aspect of affairs. The Portuguese Government was making every effort to make its finances balance, and the company hoped that it would be successful. At present the company was just struggling along, but with an improvement in exchange, capital could be raised and the system extended. There was a long list of applicants, and the capacity of the Lisbon and Oporto exchanges was nearly exhausted. The present number of direct exchange lines was 12,534, but they had hardly tapped the possibilities of the telephone business in Portugal. In Lisbon only 1 per cent. of the population was connected, and in Oporto only two-thirds of 1 per cent. The manager reported that if the company was in a position to supply the facilities, the number of subscribers could be doubled in five or six years. Plans were being considered for dealing with the difficulty, and advantage would be taken of any opportunity which might occur. The report and accounts were adopted, and the appointment of Viscount St. Davids as a member of the London board was confirmed.

International Automatic Telephone Co., Ltd.

The profits for the year 1922 were £15,903, plus £648 brought forward, making £16,546. From this are deducted directors' fees, £9; preliminary and formation expenses, part written off, £2,000; dividend on preference shares, £11,782; leaving £2,755 to be carried forward. This company is a large shareholder in the Automatic Telephone Manufacturing Co., Ltd., of Liverpool, whose results are mentioned in the report published below. The profits of this (the International) company for 1922 are slightly better than those of the previous year, but the directors regret that they are not sufficient to enable a dividend to be paid on the ordinary and deferred shares. Meeting: Liverpool, July 2nd.

Automatic Telephone Manufacturing Co., Ltd.

The profit for the year ended December, 1922, was £42,258, plus £4,313 brought forward, making £46,572. From this have to be deducted directors' fees, £1,321; debenture interest, £13,650; depreciation on patents, goodwill, buildings, plant and machinery, £6,000; proportion of development expenditure written off, £4,000; proportion of debenture issue expenses written off, £3,115; dividend on preference shares, £12,000; leaving £6,487 to be carried forward. The results for 1922 show an improvement on those of the previous year, notwithstanding the engineering lock-out which lasted for thirteen weeks. The directors again regret, however, that it is not possible to pay any dividend on the ordinary shares. Mr. E. A. Mellinger rejoined the board during the year, and Sir Andrew Ogilvie was appointed a director. Meeting: Liverpool, July 2nd.

United River Plate Telephone Co., Ltd.

The gross revenue for the year ended December 31st, 1922, amounted to £1,346,566, whilst the gross maintenance and other charges in Argentina and London were £1,155,914, leaving a profit of £190,652. Deducting interest on debenture stock and dividend on the preference shares and the interim dividend on the ordinary shares £88,300, and adding £38,705 brought forward, the balance is £141,056. The directors recommend a final dividend of 5 per cent. on the ordinary shares, making a total of 8 per cent. for the year, free of income tax at 5s. 3d. in the £, leaving £33,056 to be carried forward. The business of the company showed expansion during the year, and this would have been much greater had the late Government authorised earlier the increase in the tariffs petitioned for in 1919. This increase was granted on October 5th, 1922, and so enabled the company to immediately place orders for the equipment necessary to give service to the waiting applicants within the time prescribed by the late Government. The installation of the four automatic exchanges in Buenos Ayres was completed in February, 1923, and brought into service during that month. Mr. Percy Brailsford Lawson has been appointed a director to fill the vacancy caused by the death of Sir John Gavey.

Whitehall Electric Investments, Ltd.

The first annual meeting of this company was held on June 1st under the chairmanship of the Hon. Clive Pearson. In presenting the report and accounts, the Chairman expressed satisfaction at the results obtained from the working of the Chilean and Mexican companies in which the Whitehall Company held interests. The heavy capital expenditure incurred was having its result in increasing earnings, but the consequent benefit to the company could not show itself immediately, and the income for the current year would not show any material increase. The only point in the balance sheet which called for comment was the large amount of cash. This was satisfactory, and would prove useful in connection with the various opportunities for investment which were being considered.

Mr. Pearson then reviewed the activities of the operating companies. He said that the extension of the undertaking of the Compañia Chilena de Electricidad had not so far produced any benefit. The programme had been very extensive, including a new hydro-electric station, transmission lines, and substations, which would feed a populous district which had only been partially developed electrically. The new plant was situated at Maitenes, 35 miles from Santiago, and operated under a head of 600 ft. An auxiliary water-storage plant which would bring the capacity of the station up to 25,000 KW was under construction. The 110,000-V transmission line was in commission as far as Santiago, and further extensions were well under way. A large receiving station at Santiago was in partial service, and stations near Valparaiso and at Las Vegas were being pushed forward. Work had also commenced upon the 44,000-V subsidiary lines and stations. This company would soon be called upon to supply power to the State Railways which were being electrified, and there was in addition a large industrial load to be secured in the immediate future. The question of increased fares upon the company's tramways had not been settled, and the undertaking was therefore at a standstill so far as extensions and improvements were concerned.

The Mexican companies had shown good results as a whole. The Puebla Tramway, Light and Power Co. had recently concluded a provisional contract for the supply of power in connection with the electrification of a section of the Mexican Railway. This necessitated an extension of the company's Tuxpango station. The results of the Compañia Electrica de Tampico fulfilled expectations, although they were not up to the 1921 standard. The results of the Vera Cruz Electric Light, Power and Traction Co. had been affected by the unsettled conditions in the State. This caused a considerable falling-off in tramway receipts, making the results in general unsatisfactory. The small Orizaba and Cordoba companies had shown normal progress. The agreement between the Mexican Government and the International Bankers' Committee had been signed; this should prove a large step in the re-establishment of Mexico's prosperity. The report and accounts were adopted.

British Electric Traction Co., Ltd.

The gross profit for the year ended March 31st, 1923, was £263,824, compared with £262,895 for 1921-22. After deducting the general expenses, *viz.*, £46,894, there remains a net profit of £216,929, and after charging debenture stock interest amounting to £82,190, there remains a balance of £134,739, which the directors recommend should be applied as follows: Dividend of 6 per cent. for the year upon the cumulative participating preference stock (on account of which 3 per cent. has already been paid), £42,765; dividend of 5 per cent. for the year upon the ordinary stock (on account of which 2 per cent. has already been paid), £66,313; to be added to undivided profits account, making that account £215,362, £25,662. The amount standing to the credit of reserve account is £520,000. During the year £21,880 5 per cent. perpetual debenture stock, and £39,714 4½ per cent. second debenture stock has been purchased, and the discount amounting to £11,597 has been applied in reduction of the book value of the investments. The investments, which now stand in the balance sheet at £3,970,021, show a decrease of £17,598, compared with the preceding year. These investments yielded a revenue of £218,115, representing an average of 5.49 per cent. for the year as compared with 5.24 per cent. for the preceding year. Owing to ill-health, Mr. W. L. Madgen has resigned his seat on the board, and Mr. R. J. Howley has been appointed to fill the vacancy. Meeting: June 15th.

Italian Companies.

The report of the board of the *Società anonima Imprese Elettriche Conti* (Milan) (capital, 100,000,000 lire) records the commencement of working of the new Valdo station, and the erection of the new station at Monza. The accounts closed with an available balance of 7,247,518 lire, from which a dividend of 9 per cent. was declared.

The *Società Emiliana di Esercizi Elettrici*, of Parma (capital 28,000,000 lire) made during the year ending on December 31st net profits of 1,734,251 lire, from which a dividend of 3 lire per old share and 0.50 lire per new share was sanctioned.

The following companies have increased their capital:—*Società Lucana Imprese Idroelettriche* (Naples), from 3,500,000 lire to 10,500,000, by the issue of 70,000 100-lire shares, half of which are taken up by the Unione Esercizi Elettrici di Milano. *Società Varesina per Imprese Elettriche* (Varese), from 12,325,000 lire to 14,500,000 lire, by raising the 80-lire shares to 100 lire, the board being authorised to increase the capital to 20,000,000 lire before 1926. *Società per le Forze Idrauliche dell'Alto Brembo* (Branzi, Bergamo), from 10,000,000 to 20,000,000 lire, by the issue of 20,000 500-lire shares. And the *Imprese Elettriche e Telefoniche Ing. T. Bormida* (Milan), from 1,600,000 to 3,200,000 lire. The company has just declared a dividend of 7 per cent. on its last year's working.

The receipts for the year 1922 of the *Società Brioschi per Imprese Elettriche* (Milan) surpassed those of the foregoing year by 3,000,000 lire, the net surplus being 2,367,706 lire, from which a dividend of 10 per cent. was distributed. Capital, 25,000,000 lire.

The *Società Varesina per Imprese Elettriche* showed a balance on the accounts of 895,250 lire, permitting the distribution of 5.25 per cent. per share on the capital of 12,325,000 lire.

The *Società Idroelettrica Comacina* (Como), whose capital is 8,000,000 lire, declared a dividend of 10 per cent. from a net balance of 876,644 lire.

The year's working to December 31st of the *Società Gas ed Elettricità di Erbina Incino* permitted an allotment of 20 lire per share on its 2,000,000 lire capital.

Owing to the effects caused by the persistent drought, both the *Società Elettrica del Veneto Centrale* and the *Società Elettrica del Porto Industriale di Venezia* carried over the small profits earned.

The *Società Elettrica della Venezia Giulia* (Trieste) declared a dividend of 4.5 per cent. on its 20,000,000 lire of capital.

The *Società Elettrica Saronnese* closed the past year's working with a net profit of 175,059 lire, which with 100,000 lire drawn from the old reserve fund justified the distribution of 10 lire per share.

A dividend of 10 per cent. on its 100,000 lire capital was distributed by the *Società anonima Impresa Elettrica Negrini* as a result of net profits of 13,490 lire.

The *Società Italiana per l'Utilizzazione delle Forze Idrauliche del Veneto* suffered in the past year from the effects of the prolonged drought, compelling resort to the reserve heat stations, which naturally increased the working costs. Notwithstanding this, a profit of 4,627,581 lire was earned, which allowed of a distribution equal to 8 per cent. on its 49,000,000 lire of capital.

The results of the year's working of the *Società Elettrica Alto Cremonese*, of Milan, was a profit balance of 226,293 lire, from which a dividend of 12 lire per share on its capital of 1,600,000 lire was distributed.

The report of the *Società anonima di Elettricità del Ticino* shows that from the distribution of current supplied by the Imprese Conti a profit of 311,906 lire had been earned, which allowed of the distribution of a 20 per cent. dividend.

The past year's working of the *Società di Elettricità A. Volta*, of Pavia, is a profit balance of 297,583 lire, which allowed of a dividend of 10 lire per share.

Swedish Companies.

The directors of *Ericsson's Mexican Telephone Co.* report net profits of 677,000 kr. for 1922, as compared with 723,000 kr. in the previous year. It is proposed to pay a dividend at the rate of 12 per cent., as in 1921.

The report of the *General Telephone Co. L.M. Ericsson* shows net profits of 2,267,000 kr. for 1922, as compared with 2,720,000 kr. in 1921, and the rate of dividend is 5 per cent., as in the preceding year.

The *Jungner Accumulator Co.* states that a loss of 133,000 kr. was incurred last year, this comparing with a loss of 439,000 kr. in 1921 owing to the great writing down of stocks. The former has been covered by a transfer from the reserve fund.

The *Swedish-Danish-Russian Telephone Co.* reports a loss on the Moscow department amounting to 1,583,000 kr. in 1922, as compared with 1,390,000 kr. in 1921, and profits on the Stockholm office of 386,000 kr. as against a loss of 161,000 kr. in 1921. During the period of 1917-1922 the losses at Moscow had totalled 7,196,000 kr. The company's activity in Moscow was still at a standstill last year owing to the political conditions. The telephone network was in general being carried on intact, but with a substantial reduction in the number of subscribers. Negotiations were proceeding with the Soviet in regard to the return of the company's property in Russia. Concerning the Cedergren Telephone Co., whose shares for the most part are held by the Swedish-Danish-Russian Company, the report states that the former sold the telephone network in Warsaw during last year for 16,300,000 kr., involving the latter in a loss on its holdings of 4,404,000 kr.

Prospectuses.—*The Electric Supply Corporation Ltd.*—The subscription list opened on Friday last, and was closed on Monday, for an issue of 150,000 six per cent. cumulative preference shares of £1 each. The object of the issue is, amongst other purposes, to provide funds to redeem the outstanding £154,915 five per cent. debenture stock at £105 per cent., of which the company holds £24,914. The debenture-holders have been given the necessary six months' notice.

Tottenham District Light, Heat, & Power Co.—Tenders were receivable up to noon on Monday last for £100,000 "B" consolidated stock at £102 per cent. It was mentioned in the prospectus that "the output of electrical current for the year 1922 is eight and one-half times greater than in 1915." The company supplies gas within an area of some 30 square miles of North London suburbs and electricity in the Wood Green district.

Puebla Tramway, Light and Power Co.—For 1922 the net profit in Mexico amounted to $1,116,586 Mex., which converted into sterling at 24.5d. per peso is equivalent to £113,985. After charging all expenses, with interest and sinking funds on prior lien and first mortgage bonds, a balance of £63 has been carried to balance-sheet. A provisional contract has been entered into with the Mexican Railway Co., Ltd., for supply of power in bulk to that company, which will necessitate extension of the company's plant at Tuxpango.—*Financial News.*

American Telephone and Telegraph Co.—Quarterly dividend of $2.25 per share.

Birkdale District Electric Supply Co., Ltd.—After putting £3,500 to reserve and paying a dividend of 10 per cent. for the year on the ordinary shares, £4,705 is to be carried forward.

Altrincham Electric Supply Co., Ltd.—The profit for 1922 was £20,244. Debenture interest, premiums on debenture redemption policies, bad debts and bank interest, amounted to £6,462, leaving £13,782, plus £726 brought forward. After meeting directors' fees, preference dividend, putting £1,000 to depreciation reserve and paying 7½ per cent. on the ordinary shares and on the deferred shares a sum of £1,750, £4,599 is to be carried forward. The results of the year's working are quite satisfactory.

The Buenos Ayres Works.—The accounts of the Compania Hispano-Americana de Electricidad, of Madrid, which took over the South American undertakings of the German Transmarine Electricity Co. a few years ago, show net profits of 17,917,000 pesos for 1922, as compared with 12,859,000 pesos in the previous year. The rate of dividend is to be increased from 9 per cent. in 1921 to 11 per cent. for last year.

Buenos Ayres Lacroze Tramways Co.—The gross receipts in 1922 rose by $139,457 to $8,141,246. The net income was $2,109,879, and this, with $52,603 brought forward, made an available balance of $2,162,482. After making provision for debenture interest, amortisation, renewals, &c., there remained $516,471. It is proposed to distribute $450,000 in dividends, to place 5 per cent. to reserve, to pay 5 per cent. to the directors, and to carry forward $20,314.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Chelsea Electricity Supply Co.—247,180 ordinary shares of £1 each, fully paid, Nos. 1 to 247,180; and 30,000 preference shares of £1 each, fully paid, Nos. 370,001 to 400,000.

Pennsylvania Water and Power Co.—$1,315,000 first mortgage 5 per cent. sinking fund gold bonds.

The undermentioned securities have been ordered to be officially quoted:—

Chelsea Electricity Supply Co.—247,180 ordinary shares of £1 each, fully paid, Nos. 1 to 247,180.

Pennsylvania Water and Power Co.—$1,315,000 first mortgage sinking fund 5 per cent. gold bonds, 1940, Nos. 11,186 to 12,500, of $1,000 each.

Western Telegraph Co., Ltd.—Third quarterly interim dividend of 5s. per share, free of income tax, for the year ending June 30th, being at the rate of 10 per cent. per annum.

Lewes and District Electric Supply Co., Ltd.—After putting £819 to reserve and paying 6 per cent. for the year on the ordinary shares, £1,956 is to be carried forward.

Banbury and District Electric Supply Co., Ltd.—After putting £3,500 to reserve and paying 7½ per cent. for the year on the ordinary shares, £2,669 is to be carried forward.

Penarth Electric Lighting Co., Ltd.—After putting £1,500 to reserve and paying 7½ per cent. for the year on the ordinary shares, £3,187 is to be carried forward.

Weston-super-Mare and District Electric Supply Co., Ltd.—After putting £2,000 to reserve and paying 7½ per cent. for the year on the ordinary shares, £3,654 is to be carried forward.

Brazilian Traction, Light and Power Co.—Quarterly dividend of 1¼ per cent. on the cumulative preference shares.

Coventry Chain Co., Ltd.—Interim dividend of 6 per cent. per annum on the ordinary shares for the half-year.

Merthyr Electric Traction and Lighting Co., Ltd.—After putting £1,807 to reserve and paying 7½ per cent. for the year on the ordinary shares, £2,152 is to be carried forward.

Hart Accumulator Co., Ltd.—Net profit for 1922, £49,990, making available, with £54,341 brought forward, £104,331. According to the *Financial Times*, a further dividend of 3 per cent., making 13 per cent., is announced; £50,000 to reserve; £32,787 carried forward.

British Columbia Electric Railway Co., Ltd.—Dividends of 3½ per cent., free of tax, on the preferred and deferred ordinary stocks in respect of the year ending June 30th, 1923.

Melbourne Electric Supply Co., Ltd.—Interim dividend at the rate of 10 per cent. per annum, free of tax, on the ordinary shares.

Callender's Share and Investment Co., Ltd.—Interim dividend of 3 per cent., less tax.

STOCKS AND SHARES.

TUESDAY EVENING.

No limit can be set at present to the public's capacity for absorbing first-class stocks. The market in all gilt-edged securities is exceedingly strong. British Government's securities have led another all-round rise. This, as usual, reflects upon the prices of other investment securities, and is the main reason why new issues continue to be subscribed for with such promptitude and eagerness. Present-day promoters need have no fear of the success of their flotations, provided they can offer good stock at tempting prices. The demand tends to create supply. Trade is improving so slowly that capital is forced into Stock Exchange channels for its employment, and, until the overseas markets offer better opportunities than exist

at present, the Stock Exchange looks for no material change in a situation, the feature of which is the consistent buying of all good-class stocks and shares for the reason that there is so little else into which to put money that its owners can spare from the temptations of Epsom.

In addition to the prices quoted in our weekly lists, it will be useful, in the present temper of markets, to refer to others that are not given in our tables owing to the comparative narrowness of the market in the various stocks and shares, and which are, possibly, seen but seldom by those who are interested. Most of these quotations have moved up of late in common, and in sympathy, with those of the more popular issues :—

DESCRIPTION.	PRICE.
Calcutta Electric Supply ord.	1 9/16
Central Electric 4% debenture	89½
Chelsea Electric 4½% debenture	83
Clyde Valley 8% cum. 2nd pref. ...	12¾
Edmundsons' Electric 4½% debenture ...	74
Fife Tramway, Light 7% debenture ...	104
Kensington & Notting Hill 4% deb. ...	87½
Lancashire Electric 6% tax-free pref. ...	24/6
Llanelly & District Electric ordinary ...	20/-
Melbourne ordinary stock	167½
Melbourne 8% 1st cum. pref.	6
Midland Counties Electric ordinary ...	19/-
Midland Electric ordinary	1 19/32
Notting Hill Electric ordinary	60/-
River Plate ordinary stock	131½
Scottish Power ordinary	22/6
Smithfield Markets Electric	4½
South Metropolitan ordinary	1 9/16
Yorkshire Electric ordinary	27/6

The reason why most of these stocks and shares are not covered by our weekly price-lists is, of course, the fact that the market is more or less restricted, and there is not sufficient public interest to justify their inclusion in a weekly catalogue. To take one example, Smithfield Markets ordinary shares have not changed hands since April 6th, a couple of months ago, when the last recorded bargain was at 82s. 6d.; Midland Counties ordinary shares have not been marked in the Stock Exchange Official List as having been dealt in since May 9th. And so the list might be extended.

The Electric Supply Corporation's new issue of £150,000 in 6 per cent. preference shares at 20s. does not seem to have been a great success, and it is said that the public did not take by any means all the shares that were offered. Possibly if a little more temptation had been held out to the holders of the company's debenture stock, which is to be paid off out of the proceeds of this preference share issue, the latter might have been more readily taken up. London Electric shares have been a good market at 4⅞, and it is hinted that towards the end of this week shareholders are likely to receive a bonus in the shape of shares. St. James's ordinary are 10s. up at 11¼, so are Kensingtons at 9½. Smaller improvements have been secured by Charing Cross preference, City ordinary, and Edmundsons.

Edisons have fallen to 3s. 9d., a drop of 6d., but the 5 per cent. debenture stock is another point higher at 67. Electric Constructions are good at 29s. 6d. on the 10 per cent. dividend, and General Electric preference at 24s. 6d. are 9d. better, the ordinary remaining at 20s. 6d. Attention has been called to the fact that the Pirelli 7 per cent. first mortgage debenture stock can be bought at 103 to give a yield of nearly 6 per cent. on the money, the issue being guaranteed unconditionally by the General Electric, whose 6½ per cent. preference shares pay less than 5¼ per cent. on money invested at the present price. The Pirelli debenture may turn out to be, however, a short-dated security, as the company has power to redeem it at 100 by drawings which begin in February, 1926. Babcock and Wilcox recovered to 2¼, and other manufacturing issues are steady without showing much change.

Metropolitan Railway stock is good at 73½, and Districts at 56 are also ¼ up. The former company paid 3½ per cent. for last year, and the District distributed 3 per cent. Stock Exchange speculation concerns itself with the possibility of the District paying 4 per cent. in respect of the present year, a rate which the Metropolitan may also declare. Underground income stock has eased off to 97, the £10 shares being lower at 3½.

Anglo-American Telegraph preferred at 105 is ½ up, and Western Telegraphs rose to 18¾. West India and Panama ordinary, however, have dropped to 1s. 6d., bargains having been marked at 6d. during the past few days, while the two preferences are both in the neighbourhood of 10s., this being due, of course, to the unhappy report issued last week. Marconis strengthened a little to 2½, but, in the absence of business, sagged back again to their previous price.

The traction issues are generally better. The Mexican group is good, the Light & Power common shares at 37½ being 3 up, following upon their rise of equal amount last week. British Columbia Electric stocks are firm. British Electric Traction ordinary at 78½ is 1 higher, and the tone of this market is hard throughout. Armament shares are uninteresting. The same remark applies to the rubber share market, where business has fallen away to a minimum owing to the failure of the raw produce to make the headway which its supporters had been expecting.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price June 5. 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	36/6	—	£6 11 4
Charing Cross Ordinary ...	5	9	14	12	—	5 16 8
do. do. do. 4½ Pref.	5	4½	4½	4⅞	+ ⅛	5 2 10
Chelsea	1	6	10	1⅞	—	5 14 3
City of London	1	14	15	2 1/16	+ 1/16	6 3 0
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 4 4
County of London	1	8	10	38/9	—	5 3 3
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 4 4
Edmundson's Ordinary	3	Nil	—	2⅜	+ ⅛	Nil
do. 6 % Pref. ...	5	12/-	—	4⅛	—	6 8 0
Kensington Ordinary	5	10	12	9½	+ ½	6 6 4
London Electric	3	4	10	4⅛	+ ⅛	6 3 1
do. do. 6 % Pref. ...	5	6	6	5⅞	+ ½	5 11 7
Metropolitan	1	7	8½	29/-	—	5 17 4
do. 4½ % Pref.	1	4½	4½	18/-	—	5 0 0
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	7/8	—	2 17 2
do. 5 % Pref. ...	1	5	5	16/3	—	6 3 1
do. 7 % Pref. ...	1	7	7	24/6	—	5 14 2
Notting Hill, 6 per cent. Pref....	10	6	6	9⅛	—	6 9 9
North Met. Elec., 6 % Pref. ...	1	6	6	1 1/16	—	5 13 0
Urban Ordinary	3	Nil	—	1⅝	—	Nil
do. 5 % Pref. ...	5	2½	—	4½	—	5 11 1
St. James' and Pall Mall ...	5	12	14½	11½	+ ½	6 6 1
South London	1	7	10	1⅞	—	5 14 3
South Metropolitan Pref. ...	1	7	7	1⅛	—	5 12 0
Westminster Ordinary	5	10	12	9⅞	—	6 3 1
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	20/-	+ 6d.	7 10 0

HOME RAILS.

Central London Ord. Assented	Stock	4	4	74	—	5 8 1
Metropolitan	,,	2½	3½	73½	+ ½	4 15 3
do. District	,,	1	3	56	+ ½	5 7 2
Underground Electric Ordinary	10	Nil	Nil	3⅛	— ⅛	Nil
do. do. "A" ...	1	Nil	Nil	8/6	—	Nil
do. do. Income	Stock	4	5	97	— ½	*5 3 1

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	5	5	105	+ ½	5 14 3
do. Def.	,,	1½	34/6	23	—	6 10 5
Chile Telephone	5	6	6	6½	—	4 18 0
Cuba Sub. Ord.	10	7	7	7½	—	9 6 8
Eastern Extension	10	10	10	18⅝	—	5 6 8
Eastern Tel. Ord....	Stock	10	10	187½	—	5 6 8
Globe Tel. and T. Ord.	10	10	10	19	—	5 5 3
do. do. Pref.... ...	10	6	6	11⅜	+ ⅛	5 2 2
Great Northern Tel.	10	24	22	28½xd	—	7 5 *6
Indo-European	25	10	7	31½	—	5 11 1
Marconi	1	25	15	2⅝	—	6 9 10
Oriental Telephone Ord. ...	1	12	12	25	—	*4 3 6
United R. Plate Tel.	5	8	8	7½	—	*5 10 4
West India and Panama ...	10	Nil	Nil	1/6	—2/3	Nil
Western Telegraph	10	10	10	18⅜	+ ⅛	*5 6 8

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	8 7/16	—	8 6 0
do. do. 2nd Pref.	5	Nil	5½	3	+ 1/16	9 3 4
do. do. 5 % Deb.	Stock	5	5	79½xd	—	6 5 9
British Electric Traction Ord.	,,	4½	5	78½	+1	6 7 5
do. do. 6 % Pref.	,,	6	6	100	—	6 0 0
Brazil Tractions...	100	Nil	Nil	51	—	7 16 10
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	89½	—	5 11 9
do. do. Preferred	,,	5	98/-	79½	+1	*5 18 6
do. do. Deferred		8	124/-	89½	+2	*6 18 0
do. do. Deb. ...	,,	4½	4½	81	—	5 5 0
Lond. & Sub. Trac. 5 % Pref.	1	2½	3½	11/-	—	9 2 0
London United Tram. Deb. ...	Stock	4	4	65½	—	6 2 2
Mexico Tram. 5 % Bonds ...	—	Nil	Nil	35½	—	5 17 0
do. 6 % Bonds ...	—	Nil	Nil	61½	—	Nil
Mexican Light Common ...	100	Nil	Nil	37½	+3	Nil
do. Pref.	100	Nil	Nil	61½	+1	Nil
do. 1st Bonds ...	—	Nil	5	75½	—1	6 12 5

MANUFACTURING COMPANIES

Babcock & Wilcox	1	15	20	2¼	+ 1/16	4 9 1
British Aluminium Ord. ...	1	10	5	20/9	—	4 16 5
British Insulated Ord.	1	15	15	9½	—	6 0 0
Callenders...	1	15	15	3 1/16xd	+1/6	6 3 0
do. 6½ Pref.	1	6½	6½	23/9	+9d.	5 9 5
Crompton Ord.	1	10	5	⅝	— ⅛	8 0 0
Edison-Swan	1	10	Nil	3/9	—6d.	Nil
do. do. 5 % Deb.	Stock	5	5	67	+1	7 9 3
Electric Construction	1	10	10	29/6	+9d.	6 15 8
English Electric	1	8	5	17/6	—	5 14 3
do. do. Pref.	1	6	6	20/6	—	5 17 1
Gen. Elec. Pref.	1	6½	6½	24/6	+9d.	5 6 1
do. Ord.	1	10	5	20/6	—	4 17 7
Henley	1	15	15	2 1/16	—	6 3 0
do. 4½ Pref.	5	4½	4½	4½	—	5 0 0
India-Rubber	1	10	—	1/16	—	—
Met.-Vickers Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	10	10	17/-	—	Nil
Telegraph Con.	12	20	20	35½	—	*4 16 0

* Dividends paid

ELECTRICAL FITTINGS AND THE LAW OF LANDLORD AND TENANT.

(FROM A LEGAL CONTRIBUTOR.)

QUESTIONS sometimes arise as between landlord and tenant as to the ownership of electrical fittings. A tenant who incurs the expense of fitting out an old house with a complete electrical installation not unnaturally resents the complete annexation of all the fitments which he has himself purchased, while the landlord, relying on the ancient maxim, *quicquid plantatur solo solo cedit*, asserts his rights as owner of the soil by saying that whatever is annexed to the house or building must of necessity become his property.

It may be convenient to discuss this question from the severely practical point of view by considering the legal bearing of certain cases which must be of comparatively frequent occurrence; but before proceeding to consider the particular cases, it may be well to understand the general principles of law by which fixtures become vested in a landlord. The consideration whether the article is essential to the enjoyment of the premises on the one hand, or whether it is a mere convenience on the other, is a material element in deciding the character of the annexation as being complete or incomplete respectively. There are, however, certain articles which are removable as between landlord and tenant which have so become removable by custom, having regard to the reason or the *purpose* for which such annexation was made. Amongst these are certain articles of trade, agriculture, ornament, and convenience. The reason for the relaxation of the general rule in respect of these articles seems to be founded on the essentially temporary purpose for which the annexation is designed, and on the inconvenience which would arise to tenants if, by every slight attachment to the freehold, the landlord should obtain the absolute property in the article annexed. The privilege in the case of ornaments seems to be of a more limited nature than that in respect of trade fixtures. Thus it extends only to articles which are perfect chattels in themselves—and which serve for the most part as substitutes for mere movable furniture—and not to things such as conservatories or glasshouses in the nature of a building or erection, though of a temporary character and easily movable. The right of removal in any particular case depends on the particular circumstances, and all that can be said in a general way is that such right *may* be defeated either from the mode of the annexation, or from the permanent nature of the purpose for which the annexation was made (as showing that the fixture is essentially a part of the building), or from the physical injury to the freehold which would be likely to result, if the injury caused by removal would be one of a substantial nature.

Applying the foregoing principles to the solution of the problem in hand, it will be seen that electric fittings, though, *primâ facie*, some of them may be fixtures, must to a certain extent be treated as removable. Roughly speaking, the line appears to be drawn in practice between those parts of an installation which are necessarily of a permanent character, and those parts which may be altered to suit the fancy of a particular tenant. Regard must also be paid to the extent to which any particular article is affixed to the freehold. It is obvious, for instance, that wires embedded in the plaster of a wall could not by any stretch of the imagination be regarded as a fixture which a tenant was entitled to remove. It would be as fair to say that a gas pipe put in by a tenant as part of a lighting system did not become the property of a landlord. On the other hand—to go to the other extreme, it is clear that a mere incandescent lamp could not possibly be looked upon as the property of the landlord.

It is somewhat remarkable that there are few cases which throw any clear light on the subject. It was held that gas fittings do not vest in the landlord, although, curiously enough, it was decided in another case that gas fittings may be included in the sale of a house with fixtures ("Sewell *v.* Angerstein," 18 L.T. 300). There appears to be no reported decision on the subject of electrical fittings, and the questions relating to them must be answered by having recourse to first principles.

It is now proposed to deal with certain concrete cases:—

(*a*) A tenant wires a house which he holds under a lease for years. Do the wires vest in the landlord at the end of the term?

It is submitted that in this case the wires and the casing of the wires vest in the landlord, and could not be removed by the tenant unless pursuant to special powers conferred upon him by his lease. A tenant would be liable if he attempted to remove the wires.

(*b*) A landlord wires a new house, and the tenant puts in switches, distribution boards, and lamp brackets. Can he remove them at the end of his tenancy?

With regard to switches and distribution boards, these appear to the writer to fall within the category of articles which are of a permanent character, and would have to be used in practically the same form in relation to any installation. At any rate, he would be sorry to advise any tenant to remove them only to leave blank spaces on the wall to which they were affixed. With regard to lamp brackets, these appear to fall within a different category. They are often fanciful in design and very expensive. They can be removed without doing damage, often by the mere turn of a screw. In these circumstances, it appears to be clear that they are the tenant's property, which he can remove at will.

(*c*) A tenant puts in a transformer at his own cost and expense. Does the transformer vest in the landlord?

With regard to a transformer, this appears to be a separate instrument, which would clearly be easily detached, and must, in the writer's view, be treated as a tenant's fixture, which he can remove.

(*d*) A tenant puts in ceiling roses, made of metal or porcelain, and wall sockets. Do any of them belong to the landlord?

Ceiling roses appear to be very much on the border line, but it would seem that, inasmuch as they are generally ornamental objects, they should be treated as tenant's fixtures. It is probable that in case of a dispute, a reasonable landlord would agree to treat an ornamental ceiling rose as the property of his tenant and the ordinary white roses as landlord's fixtures. As to a wall socket (*i.e.*, the part into which the plug is fitted), it is conceived that this would be a tenant's fixture, as it might easily be removed and replaced by a permanent connection to a wall or bracket lamp.

(*e*) Assuming a tenant installs electric light throughout a house, can any action be brought against him by his landlord, if on finding that the landlord refuses to pay anything towards it, he deliberately cuts or damages the wires without defacing the decorations?

It is clear that if a tenant does any damage, whether by removing landlord's fixtures, or improperly removing his own, he can be held liable to make it good. The ordinary covenant to repair, and leave in repair, would clearly impose such a liability upon him.

There is one reported case which makes it plain that if anyone lets or hires electric fittings to the occupant of a house whose landlord enters for non-payment of rent, there is grave risk of his losing his property. In "British Economical Lamp Co. *v.* Empire, Mile End, and Another" (1913), 29 T.L.R. 386) an action was brought to recover a quantity of electric lamps or their

value and damages for their detention. The defendants owned a theatre, which they had entered for non-payment of rent by the tenant.

They had been in possession for a month or more when the plaintiffs, who had let the lamps on hire to the tenant, discovered what had happened. The lamps were attached in the usual way by the bayonet joint. The case was heard at the Mayor's Court, when the Recorder, holding that the lamps were trade fixtures, gave judgment for the landlords. The Divisional Court (A. T. Lawrence and Lush, JJ.) affirmed this decision, not on the ground that the lamps were fixtures, but because they found that in law the plaintiffs had no right to enter the theatre to remove the lamps. "The plaintiffs," said Mr. Justice Lawrence, "have their remedy against the persons to whom they let the lamps. If they desire to have a right against the lessors of the premises they should obtain their assent when making the letting." Mr. Justice Lush, however, expressed the view that the lamps were not fixtures. "A filament lamp, although fitted or fixed in a socket is only temporarily fixed with a view to the efficient use of the chattel itself, and that being so, it does not, in my opinion, cease to be a chattel or pass to the landlord when the term comes to an end *merely* because it happens to be in the socket at that time."

The decision is highly technical from the legal point of view; but it draws attention to the fact that a very valuable part of an installation, namely, the system of lamps, although it does not consist of fixtures, may become vested in the landlord of premises let on lease. Those who hire out lamps should therefore take note of the warning sounded by Mr. Justice A. T. Lawrence (or Lord Trevithin as he now is) of the danger which is incurred unless the consent and co-operation of the landlord is secured.

THE PRACTICAL APPLICATION OF PROXIMATE ANALYSIS IN THE SELECTION OF COALS.

By CHAS. F. WADE, A.M.I.Mech.E., A.M.I.E.E.

Although the selection of coals on a calorific value basis will be of value when dealing with samples which approximate closely in composition and properties, yet, by itself, the calorimeter test will be of little value when examining a fairly wide range of fuels from different seams or districts and which give varying proximate and ultimate analyses. The physical behaviour under working conditions will have an important effect upon the ultimate commercial value of the fuel for any given set of conditions as regards draught, &c., and the nature of the volatile constituents will largely determine the net commercial value of any given fuel.

The same arguments apply largely to an ash percentage basis of coal valuation, as such a standard can only be applied successfully to coals in which the ash is of the same composition, especially as regards its iron content. Ash of a light colour has the highest fusing point, and therefore interferes less with the efficient combustion of the fuel than ash of a redder appearance and lower fusing point. The latter description of ash has a larger percentage of iron in its composition than the lighter ash, the iron in the white and cream coloured ash being practically nil.

Before proceeding to constructive suggestions, let us review the information divulged by tests of calorific value and proximate analysis.

The calorimeter test is valuable in providing a basis figure of gross value of the coal under examination, from which figure the net commercial value of the coal can be arrived at after certain deductions have been made, these being ascertained from the results of subsequent proximate analysis. Again, after a contract has been placed for a certain class of coal, the calorimeter test will give ready information when there is any variation from the original sample.

A minor point in connection with a calorimeter test is that the heat of combustion of the sulphur in the coal is included in the result owing to the high temperature reached in the instrument. In practice, four-fifths of the sulphur remains with the ashes, and of the remaining fifth it is doubtful how much is really burned to SO_2, as a considerable proportion will be merely sublimed, with deposition within the flues or chimney. Fortunately, however, the sulphur content is usually a very low one, the average being about 1.5 per cent. If a sulphur determination is carried out in connection with the proximate analysis, this percentage should be written off as dead loss, together with the ash.

A great deal of stress has been laid upon the importance of a low percentage of moisture in coal, but this, from its effect upon the net heating value of the fuel, is of comparatively little importance from this point of view, for, under average conditions of final temperatures, the loss due to 10 per cent. of moisture in coal will only amount to a little over 1 per cent. As regards carriage charges, however, especially during snowy and stormy weather, the percentage moisture will be important as involving payment for carriage of dirty water or useless dead weight. Again, in the case of peat and lignites, the percentage moisture is so high as often to make its carriage over any appreciable distance a useless proposition financially.

The most important stage of proximate analysis is the determination of the percentage of volatile matter, as from this investigation an approximation to the percentage of hydrogen in the coal may be made, and thus can be calculated the important losses which may be incurred in the waste gases, owing to the heat carried away by the water vapour as a product of combustion. The volatile test in conjunction with the accompanying coke determination also gives us valuable information as a guide to the suitability of a coal for any given purpose, and forms a reliable basis upon which to make the first selection of coal to give the best results under the furnace conditions in which it is to be used.

The usual way of testing for volatile matter is merely to heat the sample of coal in a covered crucible at a bright red heat over a Bunsen flame, until flames and smoke cease to issue from beneath the lid of the crucible. The inaccuracy of this method is shown when it is remembered that Prof. Bone has found a variation from 31 per cent. to 43.7 per cent. in the volatile matter in similar coal heated at various temperatures from 500° to 900° C. respectively.

Prof. Bone recommends, therefore, that the volatile test be always carried out under standard conditions, in a muffle at 900° C.; otherwise the volatile tests will not be comparable one with another.

The ash test gives us not only a figure for the useless dead weight in the coal under examination, but also an indication, by means of its colour, of the amount of iron and consequent degree of fusibility. At one end of the scale we have the almost white ash whose fusing temperature is very high, and which is therefore not likely to give trouble from slagging of the firebars, and at the other extreme we have the deep chocolate-coloured ash with a low fusing point, which gives trouble from choking of the air spaces between the bars and thus interfering seriously with efficient combustion. Ash ranges in colour from white through cream, pink, red to brown, the fusing point falling in the same order. Incidentally, it may be mentioned that the colour of the

ash is no guide whatever to the appropriate use to which a coal should be put, although domestic coal merchants give prominence to this characteristic; the temperatures attained in ordinary grates are never so high as to lead to fusion of ash.

Attempts to arrive at some standard coal do not appear to have met with any success owing to the fact that a fuel which is of high value for one set of working conditions may be quite unsuitable for another set of conditions. Again, although coal ranges gradually through numerous stages from peat to anthracite, or even graphite, yet really from a practical point of view, we are dealing with what are virtually different substances at each well-marked stage of formation. Thus we cannot definitely state from mere proximate analysis and calorific test figures alone that such and such a coal is the best value for our money, for there are other factors which affect this decision and which lie outside the scope of the analysis.

A net commercial heat value can be arrived at, however, for carbonaceous fuels apart from the ultimate use of the fuel, and as a standard for comparison it is suggested that pure ash and moisture-free carbon should be adopted, this having a calorific value of 14,544 B.th.u. per lb. gross. The lower or net value will be (allowing for nitrogen loss) 13,400 B.th.u., with gases at 500 deg. F., atmospheric temperature 50 deg. F.

Assuming, then, that we have decided to adopt pure carbon as our standard fuel, with a specific value of 100 per cent., let us investigate the ultimate value of a bituminous coal with the following proximate analysis, *viz.*:—

Moisture (air dried sample) ...	6.01 per cent.
Volatile Matter	32.37 per cent.
Fixed Carbon	54.32 per cent.
Ash	7.30 per cent.
Sulphur	1.66 per cent.

Calorific value, gross=12,793 B.th.u. per lb.

Final temperature of waste gases, 500 deg. F. Atmospheric temperature, 50 deg. F.

The loss in the waste gases due to moisture will be—

$$0.0601\ (212-50+970.4+\ 0.47\ [500-212])\ =69.15$$

B.th.u., or 0.54 per cent.

The loss due to hydrogen will be found by first estimating, in the absence of ultimate analysis, the amount of this gas from such a formula as that of Diederichs, which gives us, in the case under consideration, 4.6 per cent. of hydrogen in the coal, equivalent to a moisture loss of about 500 B.th.u., or 3.9 per cent.

Under average conditions the reduction in value due to the presence of ash will be about 3 per cent., or 383 B.th.u. where 7.3 per cent. of ash is present.

From the gross calorific value of our fuel, therefore, we will have to deduct 69+500+383=952 B.th.u., leaving a net specific value of 84 per cent.

As also the sulphur may be considered to be of no available heat value, the calorific value due to this fraction will also have to be subtracted, or $4,032\times0.017$ =68.5 B.th.u. per lb., or 0.53 per cent. This deduction will now leave us with a coal value of 11,773 B.th.u., or 83.5 per cent. of pure carbon.

A little examination of the figures given will cause one to realise the great importance of the volatile content of the coal as compared with the other constituents ascertained by proximate analysis.

Taking some of the estimates of the reduction in commercial value due to the presence of ash, all of these agree that under ordinary conditions of use a fuel containing 40 per cent. of ash is of no commercial value, yet in the pulverised condition a coal with this ash percentage can be burned very efficiently. Again, with unpulverised coal, but using forced-draught steam-blown firegrates of the "Whitehead" type, the reduction in practical value due to ash content is less than with ordinary natural draught conditions.

The main difficulty in establishing an all-round standard of coal value lies in the fact that the air used for combustion is as much the fuel as the solid or other combustible material usually known by that name. To establish any standard will therefore call for standard conditions of air supply and effective grate area, and as coal is not only used for steam raising, this would have to apply to metallurgical operations as well.

The writer would therefore suggest that each individual plant be taken on its own merits, the physical considerations of coke hardness and density, ash fusibility, &c., being carefully observed in connection with a series of working trials. Thus, from personal observation, the maximum permissible degree of coke hardness and colouration of ash (as a measure of fusibility) will be carefully noted. These properties are the first to be investigated in deciding upon the suitability or otherwise of a particular sample for any particular purpose. Other things being equal, the best fuel for any specific purpose is that having the freest burning characteristics, lightest coloured ash and lowest percentage of volatile matter.

Following a preliminary sorting of samples, on the lines indicated, the fuels selected as being the most promising for the special conditions to be met are then subjected to the calorimeter test, after which the deductions already described are applied.

As a counsel of perfection, of course, all samples of coal should be submitted to ultimate analysis in order to arrive at the correct net value, as by such means the percentage of nitrogen will be arrived at, this element also having no calorific value. The sample of fuel taken as an example for proximate analysis showed a percentage of nitrogen equal to 1.34 per cent. Theoretically, nitrogen will account for a greater loss than an equal percentage of ash, as, in addition to its lack of calorific value, it will carry away a certain amount of heat to the chimney, the specific heat being 0.249.

Unfortunately, ultimate analysis calls for not only a high degree of training in organic analysis work, but also for a laboratory equipment which puts it outside the realm of practical politics in connection with the majority of undertakings. Where such an equipment is feasible there will be a man in charge of the laboratory who will not need any instruction in the way of carrying out his analyses.

As regards proximate analysis, however, this should never be neglected, and should always be carried out in conjunction with the calorimeter tests. A summary of the points to be noted in connection with each stage of this investigation is given herewith:—

Moisture.—Under all circumstances the moisture content of the coal, as received, should be as low as possible. With slack coals water may be added with advantage, as the mechanical effect causes a greater improvement in combustion than is accounted for by the heat loss directly due to the water added.

Volatile Matter.—This should be as low a percentage as possible consistently with adequate draught conditions. With large combustion space, coals containing a higher percentage of volatile matter can be more efficiently burned than is possible with restricted combustion space. Coals having a predominance of the heavier hydrocarbons, as shown by the denser coking properties, are to be avoided where possible for steam raising, especially with a restricted draught.

Fixed Carbon.—This should be as high as can be burned efficiently with the draught available, as disclosed by tests for CO_2 and CO. The higher the fixed carbon content the less is the combustion space required and also secondary air supply.

Ash.—The lighter colour or higher the fusing point the better will be the combustion of the fuel in the furnace. Ash, of course, must be as low as possible.

A point worth mentioning before concluding is that the more moisture there is present in the waste gases, whether due to water, as such, in the original fuel, added afterwards, produced by the combustion of hydrogen, or introduced by the use of steam-jet furnaces, the higher will be the temperature required at the water inlet to the economiser, in order to counteract the corrosive effects produced on the lower external ends of the pipes. Unless a proper circulator is used, the heat recovery of the economiser will suffer accordingly.

THE FINANCIAL PROSPECTS OF RAILWAY ELECTRIFICATION.

By SIR PHILIP DAWSON, M.P.

(Abstract of paper read before the INSTITUTE OF TRANSPORT.*)*

(Concluded from page 838.)

WE will now consider the results actually achieved by the electrification compared with those achieved whilst the present electrified lines were still operated by steam. Bearing in mind that, whilst as regards the South London line, serious competition existed from electric trams and motor omnibuses and much traffic had been lost, this was not the case on the Crystal Palace line.

Results on the Electrified Lines.

	Passengers carried.	Gross receipts.
Last year of steam	14,770,073	£152,578
Electric, 1913	23,473,821	£220,312
,, 1919	34,896,090	£418,201
,, 1920	36,774,056	£519,509
,, 1921	31,088,860	£526,471

The total expenditure in connection with electrification charged to capital was £814,225.

Net Receipts, Deducting Operating and Maintenance Costs.

Last year of steam	£110,996
Electric, 1919	£236,205
,, 1920	£297,363
,, 1921	£305,392

In this connection it is worth remembering that previous to electrification the operating costs with steam per train-mile were 1s. 4d., and that these had risen in 1920 to 4s. per train-mile, as compared to 3s. 9d. per train-mile in that year for the electric service.

The benefits resulting from electrification generally, and more especially the advantages of operating goods services electrically and of electric shunting, are so well known that they need not be discussed here in detail. They have been very ably dealt with in detail by a paper read before the Institute by Sir Philip Nash (*vide* March issue, Vol. II). It may, however, not be without interest to see how greatly the available terminal capacity can be increased by the substitution of electricity for steam. This is based on an actual working time-table prepared in connection with the traffic department of the railway.

Increase in Train Service due to Electrification over Steam.

Main line, Victoria	220 per cent.
Suburban line, Victoria...	225 ,,
Main line, London Bridge	142 ,,
Suburban line, London Bridge ...	206 ,,

The benefits derived from the electrification so far carried out have been publicly recognised in the speeches made by the chairmen at various annual general meetings of the London, Brighton & South Coast Railway Co.

It is generally admitted that electric traction is essential satisfactorily to operate the dense services required over suburban lines in and round our great cities. It may not be without interest to examine what the results of main line electrification to Brighton may be. A very thorough and exhaustive investigation, which took over two years to complete, has been carried out, with a view to ascertaining the financial results which may be expected from extending the suburban electrification of the Brighton Railway as far as the coast.

Table of Mileage of Brighton Electrification.

	Electrified or in course of electrification.	Completion of Brighton suburban system.	Total, purely Brighton suburban system.	Electrification to Brighton main line additional.
Route miles	42	22	64	45
Miles of single track running roads ...	123	70	193	121
Miles of siding ...	12	107	119	56

To operate the main line electrically the suburban system would have first to be electrically equipped, and in consequence of the high line pressure of 11,000 volts which would be used, little additional expenditure would be required on this portion of the system in connection with the main-line electrification. The very thorough investigation made, which involved the preparation of a complete electrification scheme in detail, has shown that, taking the total cost of this complete electrification, including the suburban and main line electrification, comprising line equipment, transmission lines, sub-stations, and rolling stock and equipment thereof, as well as all the track and station alteration entailed by electrification, and allowing for interest thereon during construction :—

(1) The ratio between the capital expenditure involved in the suburban and in the main-line electrification is as 7 is to 4.

(2) The total cost of operating the suburban lines to that involved in the operation of main-line traffic is as 7 is to 3.

(3) If the gross receipts resulting from the suburban and the main-line electrification are increased for the suburban as compared with the main line in the ratio of 2 to 1, then the net receipts in the two cases are in the ratio of 7 to 6.

In all that precedes it has been assumed that the carrying capacity is increased 140 per cent. in the case of the suburban system and 70 per cent. in the case of the main-line system. Based on the capital expenditure involved, the operating costs, and with the fares in force in 1922, an increase in gross receipts of 70 per cent. on the suburban and 35 per cent. on the main line would show a return of 8½ per cent. on the total capital expenditure required to carry out the electrification. Each further increase in the gross receipts of 20 per cent. on the suburban and 10 per cent. on the main line represents an additional 3½ per cent. on the capital expenditure.

It is interesting to note that the additional operating costs involved in providing these additional facilities over present costs (1921-22 figures), including all additional locomotive charges, maintenance of rolling stock, maintenance of traction, line and sub-station and transmission equipment and guards, represent an increase of only 42.8 per cent.

It is obvious that the relatively smaller cost involved in completing the electrification to the coast and the larger average fares realised bring it about that the most attractive portion of the electrification can only be reached when the electrification to Brighton is completed.

Brighton and the townships adjoining represent a population of about 500,000, whilst the towns and districts adjoining the line from London to Brighton number a large and well-to-do population. The South-Coast towns would become suburbs of London, and there is little doubt in the minds of those qualified to judge that an increase in gross receipts of 70 per cent. for suburban and of 35 per cent. for the electrification to Brighton are figures which, under normal conditions, should soon be materially exceeded.

The advantages which in many cases can be secured by main-line electrification are fully realised on the Continent of Europe, not only in the case of countries with little or no coal and abundantly supplied with water power, but also in the case of countries where railways are drawing their current from thermo-electric stations.

With locomotive-hauled trains, the necessity of one uniform system is not imperative, as at the present time under ordinary commercial working, locomotives are always changed at frontiers. The question of the choice of system is purely a financial one.

As regards the capital and operating costs of the various systems at present in use, the conclusions arrived at by Mr. George Gibbs, the consulting engineer of the Pennsylvania Railroad, &c., who last year acted as president of the railway electrification section of the International Railway Congress, at Rome, are instructive. He was a member of the Commission of the Illinois Central Railway, which has just completed an exhaustive study of four different types of electrification, as applied to the suburban operation in Chicago, the 750, 1,500 and 3,000-volt d.c. and 11,000-volt single-phase systems. This investigation showed that the total first cost of each system was nearly the same, but that, for long-distance work, the results were in favour of 11,000 volts single-phase. It also showed that the operating costs, as far as suburban work is concerned, are not materially different in the case of any of the four systems considered. For long-distance and heavy work the single-phase system was proved to be the most advantageous one which has so far been devised from all points of view. The opinions expressed above by Mr. George Gibbs are confirmed by the experience in heavy railway electrification in eight countries, such as Sweden, Norway, Germany, Austria and Switzerland, on the Continent of Europe, where single-phase has been adopted as the standard and where many main lines are either electrified, or in the course of electrification.

In the United States of America little new work has been taken in hand since 1913.

In the case of France and Holland, on the other hand, 1,500-volt continuous current has been adopted.

The present position as regards main-line electrification in the United States of America and on the Continent of Europe is shown in the following table :—

Main Lines Electrified or in course of Electrification in Europe and the U.S.A.

EUROPE.

	Miles of track.	Number of locos.
Single-Phase—		
Germany	800	288
Austria	500	82
Switzerland	660	175
Sweden	280	47
Three-Phase—		
Italy	500	150
Continuous Current—		
France	500	138

UNITED STATES OF AMERICA.

Single-Phase	700	130
Continuous Current	1400	220

SUMMARY.

Europe—		
Single-Phase	2,240	592
Three-Phase	500	150
Continuous Current	500	138
Total—Europe and U.S.A.—		
Single-Phase	2,940	722
Three-Phase	500	150
Continuous Current	1,900	358

In conclusion, to secure the greatest financial benefits from electrification, the system must from the very first be so designed that it can economically be extended so as to deal efficiently with the maximum train service and the maximum train formation the railway can carry.

DISCUSSION.

Opening the discussion, Sir. PHILIP NASH, K.C.M.G., said that the decision of the Advisory Committee to allow the single-phase system of the Brighton Railway Co. to be extended had been fully justified by the results given in the paper. As Sir John Aspinall had said, electrification was not intended to be the means of saving money but of making money, and that was apparently the result of the electrification of the Brighton Railway. The author stated that seat-miles, or car-miles, taken by themselves for the purposes of comparison were misleading. That was very true! The author showed that the speed of the train must be taken into consideration, otherwise justice was not done to what was one of the most important gains in electrification over steam, namely, increased speed.

Sir GEORGE PAISH said the time had arrived when electricity had to be introduced more fully, otherwise railway companies would be confronted with very great capital expenditure. The capital cost of widening lines like the Brighton line at London Bridge would be almost prohibitive, and any system which would enable that capital cost to be obviated for a very long time was of the greatest importance. He believed the time had come, not only when suburban lines should be electrified, but also main lines with a very great density of both goods and passenger traffic.

Sir JOHN A. F. ASPINALL remarked that one of the serious items in electrical operation was the cost of coal in the aggregate, but the amount of coal that was used per ton per mile really was an extraordinarily low figure—on the Liverpool and Southport line, with 150-ton trains, 0.5 lb., and on the Manchester and Bury line, with 170-ton trains, 0.4 lb. He regretted that the Electricity Commissioners had hesitated to agree to railway companies creating their own generating stations. Sometimes there were large and efficient stations close to the line of route, but there were a great many other places where railway-owned plant might be erected with very considerable advantage and with great economy. Diagrams Nos. 1 and 3 showed the tremendous rise in the traffic, and illustrated what he believed had always been the case with electric suburban lines, namely, how electrification increased the appetite for travelling. On the lines in and about Liverpool the effect after a few years of electrification had been to increase the receipts no less than three times. A very rapid increase could be obtained simply because of the frequency and the rapidity of the services which were created.

Sir WILLIAM ACWORTH, K.C.S.I., discussed the author's figures and said that a good many people were running away with the belief that they had only to electrify a line and they immediately trebled the traffic. He thought that was not true by some distance. Every line had to be considered on its merits. There should be only one system of electrification.

Mr. H. A. WATSON, C.B.E., referred to the electrification of the main line of the North-Eastern Railway between York and Newcastle, and explained the great advantage, financially, of the unification of speed which electrification was going to give. One of the great troubles of a railway operating officer was to get over an up-and-down track a large number of trains whose speeds varied. There were seven different speeds of trains running between York and Newcastle. Electrification was going to reduce those to three, and members could see at once what an enormous increase it would make in the capacity of the existing tracks to convert from steam to electricity. That was going to save his company from the cost of widening the line by putting four tracks where there were at present two. If they could run practically 90 per cent. of their train mileage at two speeds instead of five or six they would accomplish an economy which he thought could hardly be over-estimated.

Mr. G. W. PARTRIDGE said it was a great thing that this country should have the benefit of every system of traction which might be used in the British Empire, because the manufacturers of this country should have the advantage of manufacturing apparatus not only of the direct-current systems, but also the various parts of the alternating-current systems. So long as the supply of electricity was left in the hands of the present undertakers he felt that owing to the diversity factor they could always supply as cheaply as the railway companies themselves could supply. Away from towns he had no doubt that a railway company might be able to supply more cheaply than the nearest undertaker, and under those conditions might supply itself. With regard to the battle of systems he thought it would be wise if both systems were allowed to be extended.

Dr. S. PARKER SMITH said the fact that, by electrifying the railways, the consumption of coal could be halved had not yet appealed to us with sufficient force. Turning to the question of system, the greatly improved results which the author had placed before them were obtained by using the single-phase system. It was remarkable that the system which had called forth so much adverse comment in this country from engineers, and more particularly from manufacturers, had achieved such remarkable results. Suburban electrification was supposed to be the worst case possible for the single-phase system, and yet the author had shown that, on the Brighton Railway, the success of that system had been very marked. He doubted if any continuous-current system could have done any better. The losses, both in transmission and in starting were much less than with the direct-current system; it was astonishing how little was lost between the power-house and the motors with the single-phase system. He thought that accounted largely for the splendid results. It was really too early to decide which system was the better; therefore, let the Brighton electrification continue on the system which it had adopted, and let the North-Eastern railway see what it could do with the direct-current system; engineers would then have two main lines, the results from which could be compared both financially and technically.

Mr. W. A. WILLOX said that the Great Eastern Co. had improved its suburban system almost to the point of perfection by a comparatively small capital expenditure on improved signalling, improved punctuality, standardisation of locomotives and increased rolling stock capacity. Similar measures might be adopted, he thought, on other main lines.

In reply, Sir PHILIP DAWSON said the only method of deciding as to what system was the best in any given case was to work out a complete scheme, and to find out, having regard to the capital cost, to the cost of maintenance and to the cost of operation, based on the train service which was to be given and as far as possible on actual results achieved, which was the soundest system financially. Whatever system resulted in paying the biggest dividends on the capital involved, was the best for any given undertaking. There were many schemes he had investigated in connection with which he had advised the adoption of continuous current.

The investigation carried out in connection with the Committee of the Ministry of Transport two years ago, demonstrated that the division between wages, material, and current was very nearly the same for the different systems. It was somewhat in the order of 25 per cent. wages, 25 per cent. material, and 50 per cent. current. With regard to the question of generating stations, the people whose business it was to generate electricity and to sell as much as they could of it, and therefore to give the best possible results from every point of view, including real economy, were the electric power companies, and the supply of power should be in their hands. The North-Eastern and the Brighton Railways had both adopted that course, and were perfectly satisfied with it.

The increase in traffic was largely brought about by giving a train service which did not necessitate looking at a time-table. Electrification was not quite the same thing as gauges, and if in thirty years' time it was found advisable to alter a system it could be done at a comparatively small cost, compared with the cost of unifying the gauge system in Australia. The expenditure put down to capital applied (in round figures) to 22 miles of route, corresponding to 70 miles of single track, at pre-war prices. It was misleading to estimate the cost of electrification on a mileage basis, as this varied between very large limits, according to circumstances. Investigation showed that there was little or no difference in the cost of maintaining overhead and surface-contact systems; if anything, it would probably be in favour of the overhead system.

With regard to the remarks of Mr. Watson, 30 miles an hour was exactly the figure at which he himself had arrived in his calculations as to the speeds obtainable with goods trains. He had come to the same conclusion as Mr. Watson as to the very great value that unification of speed would create. One could never run a 12 or 14-minute service from London to Brighton—which was what was contemplated—unless the trains could be operated in such a manner that the difference

between the speed of the slowest and the fastest trains was reduced to a minimum. Several experiments had recently been made on the Brighton line with a full service in order to obtain the efficiency, and those tests showed that the efficiency of transmission and distribution was of the order of 97 per cent. Also, owing to the absence of resistance in accelerating which was possible when transformers were used, which could only be done with alternating-current motors, there was an increase in the efficiency during the period of acceleration which reduced the energy consumption. He had investigated the question of electrification on behalf of the Great Eastern Railway, and there could be no doubt that a greatly improved service would be out of the question with steam unless the number of tracks, both in the station and outside, was very largely increased, which would mean a capital expenditure that would hardly be faced. If this country waited long enough and allowed other nations to electrify, we might eventually get some standard system, but meanwhile those other nations would be supplied with all the apparatus by this country's competitors, and when the railways in this country electrified their lines, British manufacturers would not be in a position to supply them with the apparatus required. The figures he had given were the results of four years' work, and represented the analysis of thousands of reports and statistics. They were as accurate as it was possible to make them.

In a written communication Professor W. E. DALBY said that when the circumstances were such that advantage could be taken of the power of rapid acceleration possessed by the motor, steam power on a train could not compete with electric power; but there were conditions in which rapid acceleration was not important, as in main-line traffic, and then the relative merits depended upon other considerations. The system adopted by the Brighton Railway was known to be suitable for main-line traffic, and the system had been tested and found to be suitable for local traffic. Therefore, the peculiar merit of the system was that it was capable of being extended so as to embrace main lines as well as suburban lines, with the certainty of a successful financial result.

One set of figures in the paper was very striking. In giving the results of the electrification of the lines, Sir Philip Dawson stated that "total expenditure in connection with electrification charged to capital was £814,225." The net receipts for 1921, deducting operating and maintenance costs, were £305,391. Comparing this with the total capital expenditure, it would appear that capital was completely recovered in three years. He considered this paper to be one of the most important on the subject in recent years.

The author, in reply, stated that the amount charged to capital in connection with the electrification now in operation comprised the total cost of the electrification of the lines, *i.e.*, contact line, feeder system, switch cabins, electrical equipment of rolling stock, as well as the repair shops and all the rolling stock required for the operation of the electrified lines. The figure of 4s. per train-mile quoted in the paper referred to main-line steam working; the corresponding figure for suburban steam working was 4s. 10d. in 1920, against 3s. 9d. per train-mile for electrical operation. As regarded the question of system, a contract had just been placed by the Virginian Railway in the United States for the electrification of 134 miles of line, comprising 213 miles of single track, at a cost of $15,000,000, and after the fullest investigation the single-phase system had been adopted. Power was to be supplied by a steam-operated station having a capacity of 90,000 h.p.

NORWAY'S SLOW RECOVERY.

NORWAY'S imports of machinery last year were 36,373,000 kr. in value as compared with 63,303,000 kr. in 1921. Expressed in sterling at par the respective figures are £1,025,000 and £3,500,000. The chief reason for the decline, which, it may be added, was noticeable last year in nearly every branch of Norway's import trade, was over-trading in 1919 and 1920. The position is explained in detail in a report by Mr. C. L. Paus, H.M. Commercial Secretary at Christiania, which has recently been issued by the Department of Overseas Trade.

Mr. Paus does not commit himself to any very definite forecast of the future. An improvement in export trade has taken place but not on a particularly profitable basis. There has been an increase in industrial activity and a consequent augmented consumption of raw materials, but existing stocks have been sufficient to cover the renewed demand. Some enhancement of import activity may therefore be expected, but, at the same time, the general financial condition of the country is so uncertain that a further reduction in the purchasing power of the population is anticipated. The Commercial Secretary considers that the French occupation of the Ruhr district may result in a further increase in the demand for British goods.

The system of protecting home manufacturers in State and municipal contracts is observed, these authorities being empowered to pay considerably higher prices. Whilst trade with the United Kingdom and the United States has been impeded by the high rates of exchange, that with Germany has lately received a check owing to uncertain deliveries, and frequent requests for advanced prices. The report adds that although considerable quantities of goods have been realised at a loss, large stocks are stated still to exist, particularly of machine tools, small tools and wood-working machinery. At the present moment there seems to be a slightly increased demand for both Norwegian and foreign goods; in the case of the latter especially for cheap German machinery and tools, but also for Swedish wood-working machinery. German prices, which are extremely uneven, are now stated to have risen considerably, and it is considered possible that the time is not far distant when they will no longer tempt purchasers to risk uncertainty as to the observation of prices and time of delivery. It is thought that British exporters would be well advised to have this contingency in view and keep themselves informed through their Norwegian representatives of the trend of the market.

With regard to electrical machinery and insulated cables in particular, Mr. Paus says that throughout 1922 German manufacturers held, as in 1921, a dominating position in the market. Part of the trade was, however, secured by Sweden, and a certain amount of business in transformers and domestic heating and cooking apparatus was done by Norwegian manufacturers. The demand for new supplies for industrial purposes remains inconsiderable owing to the continued depression, but there is a fair demand for small transformers and motors and for heating and cooking apparatus in connection with the development of municipal power distribution.

National Hydro-Electric System.

It will be recalled that the committee appointed in 1918 to inquire into the question of a national plan for electricity supply, made a number of recommendations regarding a system for East Norway. Mr. Paus mentions the criticisms that these proposals have aroused.

No new hydro-electric power schemes have been projected during 1922, but work has proceeded on the development of a number of schemes previously initiated by the State and various municipalities, many of which are now approaching completion. As new supplies of energy are required only for domestic service it is thought that enterprise will for some time be confined to the realisation of schemes already adopted unless the electro-chemical and electro-metallurgical industry should receive some unforeseen impetus.

Work proceeded during 1922 on the construction of the main transmission line which is to deliver 20,000 kW from the Rjukan power station to the municipalities of Christiania and Drammen and the Buskerud county. The line is already finished between Kongsberg and Christiania, and has been taken into use for the delivery of power from Christiania to the Buskerud county, delivery of the power from Rjukan having been postponed until October 1st, 1923. In connection with the Nore power scheme, work has been continued on the tunnel and catchment basin. The State vote in aid of the scheme amounted in 1922 to 3,000,000 kr., in addition to which 5,000,000 kr. was granted for continuation of work on the projected Numedal Railway (Kongsberg to Nore).

The Hakavik installation, which was destined to supply power to the Christiania-Drammen railway, has been completed and electric trains now run between Christiania and Bragerōen, which is connected with Drammen by a bridge crossing the Drammen river. This bridge is not, however, strong enough to carry the heavy electric locomotives, and it will be necessary to construct a new one before the whole journey can be made by electric train. The installation of 77,000 h.p. (in three sets of 25,000, 25,000, and 27,000 h.p.) at Glomfjord in the Nordland county has been completed. This power is not at present employed and the State has hitherto received no return upon the large capital invested in the scheme, as a zinc-smelting company, controlled by Swedish interests, which rented 50,000 h.p., was unable to fulfil its contract. Negotiations have, however, for some time been proceeding with a view to reconstruction of the company in question, and it is believed that an arrangement will shortly be arrived at. Work has continued on the scheme to harness the Solbergfos on the river Glommen, which will probably be completed in 1924. This scheme is expected to yield 50,000 h.p., of which two-thirds will be taken by the State and one-third by the municipality of Christiania.

Municipal Schemes.

The important low-pressure power station at Raanaasfos, on the river Glommen has now been completed and taken into use, the power being delivered by the Akershus county to the various municipalities within its own borders. Six sets of 12,000 h.p. each have been installed;

the power is distributed at line voltages of 50,000 and 17,000 to sub-stations, where it is transformed down to 220 volts for house service. The Bergen Municipal Power Co., an amalgamation of the Bergen municipality, and a number of small municipalities in the Bergen district, have adopted the scheme for constructing a 100,000-h.p. station at Dale, and work has been commenced.

The scheme of the town of Kristiansand S. to harness the Nomeland fall has been completed and the power is in use. The scheme of the Nord Tróndelag county to harness the Folla watercourse will probably be completed in the spring of 1923. The scheme to harness the Tafjord watercourse in the Romsdal county is nearing completion. Work has continued on the scheme of the Troms county to procure 2,000 h.p. from the Bardo waterfall and on the scheme of the town of Fredrikshald for the erection of power stations on the Brekke and Krappeto waterfalls. The scheme of the Aalfot Power Co. to harness the Aalfot waterfall is still in suspense owing to financial difficulties.

Questions of finance and cost of materials still stand in the way of the progress of the power transmission scheme between Norway and Denmark.. It is noteworthy that Norwegian manufacturers are applying themselves to the question of standardisation in industry.

THE INTERNATIONAL MINING EXHIBITION.

The Sixth International Mining Exhibition, which was opened at the Agricultural Hall, London, on June 1st by Sir John Cadman, K.C.M.G. (president of the Institution of Mining Engineers) is the first since 1913; it remains open until June 14th. The international character of the exhibition is sustained by the official participation of the French, Belgian, Mexican and Colombian Governments, and by the presence of exhibits from the United States, Nigeria, Malaya, the Belgian Congo, and other mining areas.

An important section of this show is the "Safety in Mines" exhibit, which displays the more important advances that have been made in this direction in recent years, both by official and private workers. The Mines Department Experimental Station shows photographs and apparatus illustrating the work which has been carried out at Eskmeals in connection with coal dust and firedamp explosions, safety lamps, signalling apparatus, &c., and other organisations have displays of a similar nature.

Boiler equipment and electrical gear are much in evidence, testifying to the great forward steps which have been made in recent years in the use of electricity in mines.

One of the best switchgear exhibits is that of Messrs. Ferguson, Pailin, Ltd., who have a large stand near the entrance. The "Types B and C" ironclad gear shown is totally enclosed and proof against vermin, dust, water, and bad atmospheric effects. The draw-out type has a sliding carriage, on which are mounted the circuit breaker and operating devices, the oil tank, trip gear, time-limit attachments, current and potential transformers, and the usual instruments. The plug contacts engage with well-insulated sockets in the connection chamber and a protection screen covers the sockets when the plugs are withdrawn. Contact with live parts is made impossible by a simple interlocking system, and the speed of operation is independent of the operator. A typical draw-out, oil-immersed circuit breaker is illustrated in fig. 1, with the cover and oil tank removed from the sliding carriage. An "A" type star-delta starter for a 50-h.p. motor is shown. In this the operating mechanism is designed to ensure correct sequence of switching. When the handle is in the "off" position it cannot be put into the "run" position without passing through the "start" stage. In the running position the contact levers are securely held by a catch until tripped by hand or by the automatic releases. After tripping, the moving contacts return to the neutral or "off" position. The gear is fitted with overload and low-voltage releases. Hand tripping is effected by the depression of a large knob provided in the switch cover. If desired, each breaker can be provided with isolating switches, which will completely disconnect it from the line. A three-pole, 11,000-V outdoor type isolating switch for pole mounting is shown. This is non-automatic and is fitted with horn breaks. Another exhibit is an interlocking cubicle rigidly constructed of heavy-gauge steel plates and angle-iron. This has four compartments, in which are contained the busbars and terminals, the busbar isolating switch, an oil-immersed circuit-breaker and current transformer, and circuit isolating switches and potential transformer. Operation is by a large central handwheel moving over an indicating dial-plate.

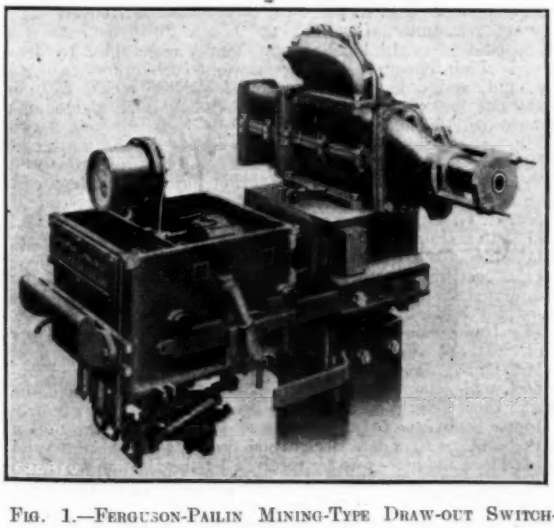


Fig. 1.—Ferguson-Pailin Mining-Type Draw-out Switchgear.

The British Thomson-Houston Co., Ltd., shows a 50-h.p., 475/550-V, mining-type, slip-ring motor and motor control pillars. The latter are provided with isolating switches when required. They are designed for four starts per hour against full-load torque. Overload and low-voltage protection is incorporated and arrangements can be made for distant control. The gear consists of a drip-proof ventilated sheet-steel pillar containing a starting rheostat, contactor-type circuit breakers opening both poles, and an overload relay. The rheostat resistances are wire-wound fire-proof tubes for the smaller sizes, and cast grids on mica-insulated rods for the larger types. The switch arm is so interlocked that it must be returned to the "off" position before the circuit breakers can be closed. The circuit breakers are fitted with arc shields, blow-outs, and renewable arcing tips. Oil-immersed and air-break mining-type drum controllers are shown. These are of various patterns, the air-break type being made "enclosed" and water-tight. The former is made to comply with Home Office regulations; the latter, in addition, has rope-packed joints. The oil-immersed controllers are either constructed with the gear mounted on a hinged lid, as in fig. 2, or else provided with a tank and lowering device. The mining-type switchgear shown includes a draw-out pillar with oil-immersed switch and cast-iron busbar chamber, connection being made by plugs and shrouded sockets.

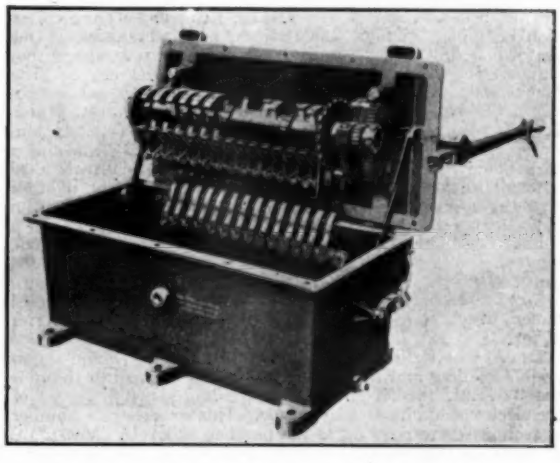


Fig. 2.—A B.T.H. Hinged-Cover Controller.

Switchgear & Cowans, Ltd., also show mining-type switchgear. This includes a two-panel draw-out switchboard for three-phase, 650-V current up to 100 A. The oil-break switches are interlocked and equipped with overload protection. Other exhibits are a draw-out, flame-proof switch pillar for 50 A, 3-phase, 650-V, fitted with colliery-type trifurcating boxes, a flame-proof ammeter, and a flame-proof earth-leakage relay set to operate with a 5 per cent. leakage; a 65-kW oil-break switch for wall or pillar mounting; gate-end oil-break switches, and transformers. One of the last is a 10-kVA variable-ratio regulating transformer for varying the secondary pressure from zero to 7,500 V with a 500-V primary.

This is designed to conform with Regulation 124 of the Coal Mines Act, 1911, and provides a convenient means for pressure-testing to earth. A 3-kVA transformer stepping down from 3,300 to 110 V for lighting purposes is shown. This is combined with an oil-break switch and oil-immersed fuses.

Fig. 3 illustrates a 3-phase, 650-V, 100-A, oil-break gate-end switch fitted with an explosion proof skid-type tank, trifurcating box, and pommel for trailing cable. "Williams-Rowley" earth-circuit protection is provided.

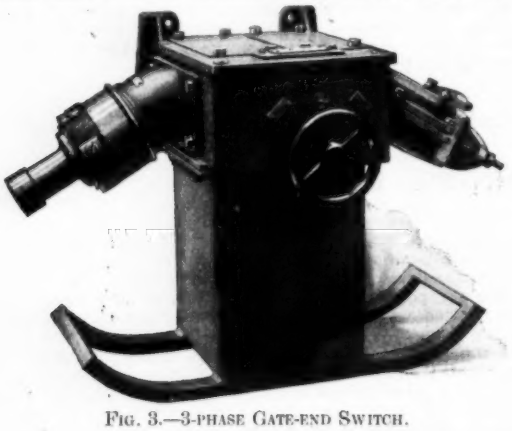


Fig. 3.—3-phase Gate-end Switch.

Messrs. Davey, Paxman & Co., Ltd., show "Economic" boilers in operation, with forced draught by Messrs. Matthews and Yates, and a locomotive-type boiler, also working. Other exhibits are horizontal and vertical steam engines, including a 50/60-h.p. "Colchester" engine working at a steam pressure of 140 lb. per sq. in., and a 25/32-h.p. vertical engine working at 100 lb. per sq. in., as well as working models of engines. A "Crosthwaite" furnace for low-grade fuel is shown.

The "Ceag" Miners' Supply Co., Ltd., has a large collection of miners' lamps, shaft lights, and accessories. One feature of the "Ceag" safety lamp is a fuse so arranged that the breaking of the well glass disconnects the lamp. The "pillarless" type is like the ordinary pattern but is provided with a swivelled reflector and a large swivelled bridle-handle. A cap lamp is also shown. This consists of an aluminium head-piece fitted with a double convex lens and a nickel-plated parabolic reflector at the centre of which is fixed a small metal-filament bulb giving a clear beam of light of uniform intensity. Non-magnetic, copper-cased lamps are on view, and torches with a combination of two lamps, giving a concentrated or diffused beam. The accessories shown include lamp-charging racks and switchboards, unlocking magnets, &c.

The Lea Recorder Co., Ltd., exhibits an example of its coal meter, which was described in our last issue, and a water meter.

The Automatic Telephone Manufacturing Co., Ltd., shows mine signalling and telephone apparatus. The main exhibit is the "A.T.M." visual and audible winding signal indicator of the electrical luminous screen type. This consists of a number of sections corresponding to the number of levels. Means are provided for reproducing the last signal sent in cases of dispute. One of the electro-mechanical switches of the type used with these indicators is undergoing a "life" test at the exhibition. Other appliances on view are magneto mining telephones, and flameproof and weatherproof bells.

Messrs. Anderson, Boyes & Co., Ltd., display electrical coal-cutters of the disk and chain type and samples of mining-type ironclad switchgear. The latter is provided with broad machined joints, and insulated throughout with mica.

Messrs. John Thompson (Wolverhampton), Ltd., have a model dish-end Lancashire boiler, a vertical boiler, and samples of tubes on their stand.

Messrs. Meldrums, Ltd., exhibit a forced-draught furnace and a model of the front of a Lancashire boiler, as well as numerous cocks, valves, and other appliances.

Messrs. Ronald Frost & Co., Ltd., show the "Raybeam" gauge-glass illuminator and the "Thermofeed" boiler-feed regulator.

The Turbine Furnace Co., Ltd., shows its patent grate and introduces a new form of staggered firebar suitable for use in burning anthracite "duff."

Messrs. Oldham & Sons, Ltd., show miners' lamps of many patterns, charging racks, and other accessories.

Messrs. Turquand & Kew, Ltd., Messrs. Worsnop & Co., Ltd., and The Wolf Safety Lamp Co., Ltd., also show miners' safety lamps.

Fullers United Electric Works, Ltd., shows lamps and charging racks, accumulators, and many samples of ebonite.

The motor-driven machinery exhibited includes haulage drums by Messrs. David Ashton & Co., Ltd., and an air-compressor by the Atlas Diesel Co., Ltd.

The Societe Alsacienne de Constructions Mecaniques shows a.c. and d.c. motors, and a cage-position indicator.

LEGAL.

Theft of Electricity.

At Manchester City Police Court, on May 31st, George Moffatt was charged with the theft of electricity to the value of £34, over a period of two years, from the Corporation Electricity Department. The solicitor for the prosecution said that defendant was an electrician, and had taken current from the mains by means of devices, the nature of which it was undesirable to make public.

The magistrates took a serious view of the case and sent defendant to prison for two months.

Nye v. Schweppes and Metropolitan Electric Tramways, Ltd.

In the Court of Appeal, before Lord Justices Banks, Scrutton and Atkin, on May 31st, the hearing was concluded of this case upon the appeal of the tramway company from the verdict and judgment entered at the trial before the Lord Chief Justice and a special jury, in the King's Bench Division.

The action was a test one, the question being which of the defendants was liable for the tramway accident in the Edgware Road, Hendon, which happened on July 27th, 1922.

The Plaintiff, Mr. George Nye, who was one of the injured persons, claimed damages from both the defendant companies, alleging negligence on the part of both of their servants.

The trial, which lasted several days, resulted in a verdict and judgment in favour of Mr. Nye, against the Tramway Co. for £1,500 damages, and costs, that company now appealing upon the main ground that the verdict was against the weight of the evidence. In the result, their Lordships held that as there was evidence to support the verdict of the jury, the appeal failed and must be dismissed with costs.

Bastian Electric Co., Ltd., v. Jennings and Another.

In the Mayor's and City of London Court, on June 5th, before Judge Shewell Cooper, the plaintiffs in this case claimed £57 from Messrs. J. W. Jennings and Charles Larder for tanks, &c., supplied. Defendants raised a counter-claim for moneys received by plaintiffs as payment from customers or others for geysers ordered from or supplied by the plaintiffs as sales managers for the defendants. Mr. Oddy appeared for the plaintiffs and Mr. Quass for the defendants. Mr. Oddy said the claim was made by the receiver for the debenture holders, Mr. Harold G. Ash. An agreement was entered into on August 10th, 1921, between the plaintiffs and the defendants, and it was agreed pending the completion of the defendants' commercial organisation for handling the "Rock" safety geysers that the plaintiffs should act as sales managers. The moneys collected from customers were to be applied as follows: In payment of the cost to the plaintiffs of the finished product, the cost of testing and inspection, and paying the delivery charges, and an agreed 4s. royalty per geyser. Plaintiffs were to be paid 50 per cent. of the total arrived at. The balance remaining after making certain disbursements was to be paid as might be directed. This was accepted by Jennings. Plaintiffs proceeded to carry out such orders as came to hand, and ordered certain tanks, valves, cocks, &c., to carry out the work, but on November 8th, 1921, defendants determined the agreement.

Mr. Quass said Larder was not concerned in the matter at all; the sole contract was with Jennings. Plaintiffs now said they had sold the geysers at a lower price than they cost to make; they could not do that.

Mr. C. O. Bastian, managing director of the Bastian Co., said that nothing was said as to what was to happen if there was a loss. Witness added that as soon as there was a prospect of getting an order for 130 of the geysers defendants terminated the agreement with the Bastian Co. The geysers were not sold at a profit.

The Judge said that it appeared to him that if the 50 per cent. was not available the Bastian Co. would lose it.

Mr. Oddy urged that that would be very harsh and unconscionable, because the plaintiffs had had to do all the work; they were to have had the 50 per cent. in any event.

Judge Shewell Cooper dismissed Larder from the action with costs, and made a declaration ordering an account, and he declared the money to be received by the Bastian Co. from customers was to be devoted to the purposes specified in the agreement in order and not *pari passu*.

Mr. Quass said on that judgment there could be nothing due to the plaintiffs from the defendant.

Judge Shewell Cooper said that there might be something due to the defendants when the account was taken; the parties should endeavour to come to some arrangement.

British Thomson-Houston Patents.

In the Chancery Division on Tuesday Mr. Justice Russell made an order for an injunction restraining Smith, Owen & Co., of Uxbridge Road, Shepherd's Bush, from infringing patents granted to the British Thomson-Houston Co., Ltd., for improvements in incandescent electric lamps.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

"Auto-valve" Lightning Arresters.

In the "Auto-Valve" lightning arresters, designed by The Westinghouse Electric and Manufacturing Co., the valve characteristics which have made the electrolytic arrester the outstanding protective device for large and important installations, have been secured, and at the same time the natural simplicity of the spark gap arrester and its freedom from the necessity for maintenance have been retained. The basis of the construction is a unit consisting of a very short spark gap between electrodes of considerable area, which are made of material of high resistivity. The resistivity of the electrodes forces the discharge in the gap to spread out over the area of the electrode, thus preventing the localisation of the current and the formation of hot spots. So long as hot spots are prevented the discharge does not become an arc, but remains in the form of a "glow discharge." The advantage of the glow discharge over the arc for such an application comes from several characteristics, among which the most important is that the voltage across the discharge is practically constant regardless of current density and is comparatively high, approximately 350 V. By the use of insulating spacers in contact with the electrodes to establish the gap lengths, the breakdown voltage of the gaps is also made approximately 350 V. As a result of this construction the arresters have the invaluable valve characteristics, that is, current does not flow until a predetermined voltage is reached, and for voltages above this value the current is proportional to the excess voltage. No current flows due to voltages below the predetermined critical value. When a short-time excess voltage is

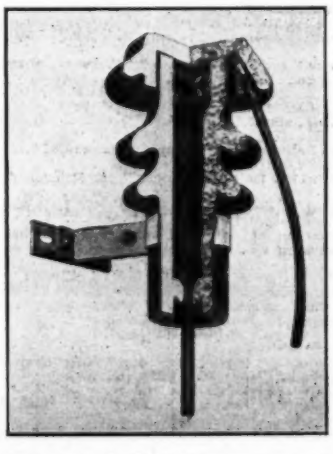


Fig. 1.—Construction of 7,500-V Lightning Arrester.

applied, current flows only due to the excess, and, assuming proper design by which the critical voltage is made higher than the voltage of the line to which the arrester is applied, after the surge voltage is relieved the current flow ceases. This removes all the limitations in the reduction in the resistance to the flow of surge current which is imposed in the spark gap and resistance type of arrester. It is quite possible to provide arresters with resistance as low as desired, the only essential being the use of electrodes of sufficient area.

The actual choice of resistance values to be employed was a matter of some difficulty, since attention had to be directed not only to the performance, but also to the permissible size and cost of the structures. The ultimate choice resulted in arresters in which the resistance at the voltages which may be anticipated in service is of the order of 5 to 6 ohms per 1,000 line volts. This very radical improvement, which is accomplished without increase in cost, makes it now possible to secure protection for distribution systems which will practically eliminate service interruptions and transformer losses due to lightning and surge voltages.

The working parts of the auto-valve distribution arresters are illustrated in fig. 1. They consist of a column of flat circular disks, ¼ in. thick and 2 in. in diameter, separated by thin mica washers from 3 to 5 mils thick. This column is connected between line and earth through a series spark gap. The number of disks is made directly proportional to the line voltage. Disks and gap are enclosed in a porcelain casing with a line lead brought out at the top and a ground lead at the bottom. The arresters are arranged for mounting on cross-arms by means of galvanised steel mounting brackets. The brackets are arranged to permit mounting of the bracket alone on the cross-arm and assembly of the arrester in the bracket after it is mounted. The arrester is merely dropped into a ring provided in the bracket and a clamping screw tightened to secure it in place. To suit various connections the arrester may be turned in the bracket at any angle desired.

An Electrical Percussive Tool.

We herewith illustrate (fig. 2) a cylindrical-shaped tool for the chipping or cutting of such materials as marble, brass, copper, &c. The outer case of the tool is made of phosphor bronze, whilst the working parts are of hardened steel. The tool is worked by a vertical electric motor of ¼ h.p., to which is attached a suitable flexible shaft 5 ft. in length. The tool works at 2,000 blows per minute, whilst the stroke of the blow can be regulated to suit requirements of various materials. The motor can be suspended and run on a rail track if desired, and thus is quite transportable, or it may be hung up over the working bench. This tool does clean chipping work, and does it quickly, and should be very useful for various industrial purposes.

By simply unscrewing the tool part from the flexible shaft, emery or carborundum grinding wheels fitted with ball-bearings can be attached,

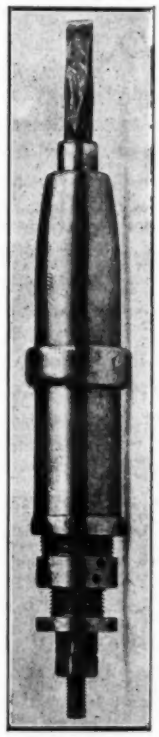


Fig. 2.—An Electrical Percussive Tool.

Fig. 3.—The "Crypto" Rectifier.

thus making the machine a compound outfit for cutting and grinding purposes.

The patentees and makers of this machine are Messrs. Borrowdale Bros., Durham Road, Sunderland.

The "Crypto" Rectifier.

The "Crypto" rectifier, made by The Crypto Electrical Co., Ltd., Acton Lane, Willesden, N.W.10, and illustrated in fig. 3, has been designed especially for the charging of accumulators for radio receiving sets, although it may be employed in other directions. It consists essentially of a synchronous motor run from the a.c. supply, which also feeds the primary of a suitably-wound transformer. The current from the low-pressure winding of the transformer is converted by means of a commutator mounted on the shaft of the motor. This commutator is in two parts and there are four brushes upon it—two opposed a.c. brushes and two for the d.c. supply. The motor is self-starting and can be switched direct on to the line, the necessary starting torque being obtained by means of a special starting winding, which is cut out automatically by a centrifugal switch when the rotor reaches synchronous speed. The spindle is vertical and the bottom end-plate of the machine is provided with legs with sufficient clearance to mount the static transformer. A specially-designed charging board is supplied with the rectifier. A series regulator is fitted, but if it is necessary to reduce the voltage further an additional tapping on the l.p. side of the transformer can be utilised.

The machine is made in several sizes, the smallest giving an output of 5 A at 15 V. It can be built of sufficient size to give 70 A at 60 V.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

13,405. "Electric conduits, &c." H. F. McLoughlin and Simplex Conduits, Ltd. May 22nd.
13,409. "Terminal members for electric cables." H. Stanbridge. May 22nd.
13,411. "Electric fuse-holder." J. S. Wilson. May 22nd.
13,415. "Rheostats." A. W. Lotinga. May 22nd.
13,429. "Three-way electric switches." F. Whipp and Whipp & Bourne, Ltd. May 22nd.
13,430. "Three-way electric switches." F. Whipp and Whipp & Bourne, Ltd. May 22nd.
13,431. "Ignition systems for internal-combustion engines." T. Butcher. May 22nd.
13,451. "High-frequency intervalve coupling unit." S. S. Richardson. May 22nd.
13,464. "Aerials for wireless telegraphy." H. L. McMichael. May 22nd.
13,499. "Variable inductance." J. A. Sang. May 22nd.
13,517. "Variometers." B. Hesketh. May 22nd.
13,518. "Attachment for receivers used in wireless telephony." G. Olivotto. May 22nd.
13,523. "Means for variable coupling between high-frequency tuning and reactance coils." T. G. Weaire and Wright & Weaire, Ltd. May 22nd.
13,524. "Sound-reproducing machines, &c." L. F. Gardner (Weinmann). May 22nd.
13,526. "Electric condensers." C. E. Vawter. May 22nd. (United States, May 23rd, 1922.)
13,530. "Balancing machines." Metropolitan-Vickers Electrical Co., Ltd. May 22nd. (United States, May 31st, 1922.)
13,533. "Sound-reproducing, &c., machines." C. Lott. May 22nd. (Germany, May 19th, 1922.)
13,541. "Electric ignition system for gas burners." E. T. Banszhaf. May 22nd.
13,544. "Electromagnetic make, break, and resetting mechanism." A. S. Waddington. May 22nd.
13,554. "Means for rectifying alternating electric currents." F. H. Muirhead and Muirhead & Co., Ltd. May 22nd.
13,555. "Installations for illuminating, &c., landing places in aerodromes." Naamlooze Vennootschap Philips' Machinerieën-en Apparaten Fabrieken. May 22nd. (Germany, January 23rd.)
13,576. "Protective devices for alternating-current systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 22nd.
13,579. "Crystal detector for wireless receiving sets." W. J. Oliver. May 22nd.
13,584. "Miners' lamps, &c." W. T. Coulson. May 23rd.
13,600. "Battery terminals." A. P. Scully. May 23rd.
13,602. "Control of induction motors." T. F. Wall. May 23rd.
13,616. "Manufacture of paper-insulated electric cables." C. J. Beaver and W. T. Glover & Co., Ltd. May 23rd.
13,618. "Vacuum tube amplifier systems, &c." Western Electric Co., Ltd. May 23rd. (United States, May 23rd, 1922.)
13,628. "Electric starting and stopping devices for talking machines." C. Lott. May 23rd. (Germany, May 23rd, 1922.)
13,630. "Adjustable headlights for motor-cars, &c." P. Mohr. May 23rd.
13,637. "Variable inductance devices." S. E. Langley. May 23rd.
13,667. "Arc-current electric generators." H. Wade (White Fuel Oil Engineering Corporation). May 23rd.
13,671. "Wireless receiving circuits." P. G. A. H. Voigt. May 23rd.
13,683. "Electric condensers." W. Dubilier. May 23rd.
13,684. "Electric condensers." W. Dubilier. May 23rd. (United States, May 23rd, 1922.)
13,685. "Dynamos." E. C. R. Marks (Ideal Electric and Manufacturing Co.). May 23rd.
13,687. "Apparatus for determining dielectric strength." A. W. Empson. May 23rd.
13,689. "Electric drives for printing presses, &c." British Thomson-Houston Co., Ltd., and H. Dreghorn. May 23rd.
13,694. "Railway, road, &c., storage battery-propelled locomotives, &c." W. P. Durtnall. May 24th.
13,696. "Safety device for colliery trams." P. Phillips. May 24th.
13,716. "Sparking plugs." W. H. Duffett. May 24th.
13,733. "Automotive driving and electric current-producing machine." H. P. Rapinet. May 24th.
13,739. "Electric motor-control systems." A. H. Jackson. May 24th.
13,744. "Electricity measuring instrument for direct currents." W. B. Good. May 24th.
13,748. "Electric arrangements for controlling movement of a switch." E. A. Richards and Siemens Bros. & Co., Ltd. May 24th.
13,756. "Electric control systems." Igranic Electric Co., Ltd., and M. J. Rantzen. May 24th.
13,771. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. May 24th. (United States, September 11th, 1922.)
13,776. "Electric cables." Callender's Cable and Construction Co., Ltd., and J. B. Gall. May 24th.
13,777. "Electric cables." Callender's Cable and Construction Co., Ltd., and J. B. Gall. May 24th.
13,792. "Automatic sprags for wheels of colliery trams, &c." A. F. Andrews. May 25th.
13,807. "Electro-magnetic sound apparatus." B. A. Pilkington. May 25th.
13,815. "Electrical instruments." M. B. Field. May 25th.
13,822. "Lighting systems." R. H. Mulock. May 25th.
13,841. "Measuring electric currents." B. A. G. Churcher and Metropolitan-Vickers Electrical Co., Ltd. May 25th.
13,843. "Temperature-controlled electric switch." Soc. Anon. Calor. May 25th. (France, May 29th, 1922.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

32,598. "Vacuum valves for train-control systems." J. B. Regan. December 5th, 1921. (197,350.)
33,027. "Trucks for tramcars and the like." W. Forber. December 9th, 1921. (197,355.)
33,718. "Direct-current rotary transformers with arbitrarily variable subdivision of pressure." A. Della-Riccia. December 16th, 1920. (172,969.)

1922.

2,871. "Protective devices for enclosed electrical apparatus." British Thomson-Houston Co., Ltd., and F. H. Clough. October 31st, 1922. (197,364.)
2,902. "Mounting of headlights of motor vehicles." W. O. Broadhurst and E. F. Filer. November 1st, 1922. (197,365.)
3,013. "Leading-in wires for electric incandescent lamps or the like." H. Lahr. February 2nd, 1921. (174,940.)
3,345. "Electric signalling systems." N. Lea, J. Ree, and Radio Communication Co., Ltd. February 4th, 1922. (197,366.)
3,616. "Electrically-heated hair-waving appliances." G. Boudou. February 7th, 1922. (197,383.)
3,653. "Rotary contact devices for timing and distributing the sparking for electric ignition in internal-combustion engines." S. George (J. H. George). February 8th, 1922. (197,384.)
3,977. "Anti-dizzle lamps." H. H. Golightly. February 10th, 1922. (197,401.)
3,982. "Telautography." H. G. Bartholomew and M. L. D. McFarlane. February 10th, 1922. (197,420.)
4,078. "Receiving arrangements for electromagnetic waves." T. H. Kinman. February 11th, 1922. (197,405.)
4,109. "Electro-dynamic power transmitting mechanisms." J. F. Gill and J. N. Chaviara. February 11th, 1922. (197,406.)
4,191. "Alternating-current dynamo-electric machines." L. Miller, A. B. Field, and Metropolitan-Vickers Electrical Co., Ltd. February 13th, 1922. (197,410.)
4,413. "Lightning or surge arresters for electric conductors." W. M. Thornton and A. Reyrolle & Co., Ltd. February 15th, 1922. (197,420.)
4,557. "Sand-pipe control arrangement for electric cars." J. Reid. February 16th, 1922. (197,424.)
4,938. "Loud-sounding telephones." G. R. Judge. February 20th, 1922. (197,435.)
5,065. "Sound horns of sound-recording and reproducing instruments." A. Pedley. February 21st, 1922. (197,437.)
5,489. "Automatic electric commutators or switches." M. Y. L. Dufour. February 24th, 1922. (197,445.)
6,222. "Electric motor control systems." British Thomson-Houston Co., Ltd. (Compagnie Française Thomson-Houston). March 2nd, 1922. (197,454.)
6,232. "Reciprocating rotary electric switches." Hart Manufacturing Co. May 3rd, 1921. (179,513.)
6,592. "Railway and tramway vehicles." Leeds Forge Co., Ltd., and H. N. Gresley. March 6th, 1922. (197,461.)
6,713. "Electrical contact makers for use with the steering wheels of motor vehicles." Eural Patents, Ltd., and H. J. Walker. December 2nd, 1922. (Patent of addition not granted.) (197,462.)
6,867. "Interrupters for use in electric ignition systems of internal-combustion engines." J. Higginson. March 8th, 1922. (197,464.)
7,240. "Protective devices for direct-current circuits." L. C. Grant, R. W. Gregory, and Electrical Improvements, Ltd. March 11th, 1922. (197,468.)
7,258. "Electric incandescent lamps or the like." General Electric Co., Ltd., and J. J. Gracie. March 11th, 1922. (197,469.)
7,969. "Windings of alternating-current dynamo-electric machines." British Thomson-Houston Co., Ltd., H. W. Taylor, and K. R. Hopkirk. March 18th, 1922. (197,477.)
8,078. "Electrical condensers and method of making them." Wireless Specialty Apparatus Co. March 30th, 1921.) (177,776.)
8,244. "Apparatus for feeding polyphase mercury vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. March 24th, 1921.) (177,525.)
8,639. "Electrically-propelled coke trucks." Electricars, Ltd., and J. P. Kemp. March 24th, 1922. (197,484.)
8,909. "Terminal banks for automatic telephone switches and the like." Coventry Automatic Telephones, Ltd. (A. H. Adams). March 28th, 1922. (197,486.)
8,914. "Telephone exchange systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). March 28th, 1922. (197,487.)
9,294. "Electric insulators." A. E. Wilson and Callender's Cable and Construction Co., Ltd. March 31st, 1922. (197,490.)
9,459. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. April 1st, 1921. (177,806.)
9,467. "Antenna systems for wireless communication." E. Y. Robinson. April 1st, 1922. (197,492.)
10,373. "Brush holders for electric motors." A. Melotte. April 11th, 1922. (197,501.)
10,382. "Charging of electric accumulators." M. J. Railing, C. C. Garrard, and W. Wilson. April 11th, 1922. (197,502.)
10,480. "Transmission of telephone numbers or the like." Automatic Telephone Manufacturing Co., Ltd., and H. H. Harrison. April 12th, 1922. (197,503.)
10,507. "Telephone repeater circuits." General Electric Co., Ltd., and G. C. Marris. April 12th, 1922. (Cognate application 35,189/22.) (197,504.)
11,304. "Instrument transformer with variable-current ranges." Landis and Gyr Akt. Ges. April 21st, 1921. (178,857.)
13,215. "Electric relays." British Thomson-Houston Co., Ltd. July 5th, 1921. (182,769.)
13,602. "Apparatus for forming the depolarising element of primary cells." V. E. Richards. May 15th, 1922. (197,542.)
14,038. "Thermostat for electric fire-alarm systems." H. A. Gill (Vigilant Automatic Fire Alarm Co., Ltd.). May 18th, 1922. (Addition to 177,567.) (197,546.)
14,203. "Electric horns." O. Lucas and H. W. F. Ireland. May 19th, 1922. (197,548.)
14,513. "Loaded signalling conductors." Western Electric Co., Ltd. August 16th, 1921. (184,776.)
14,917. "Electro-magnetic control devices for signalling apparatus." Soc. Internationale M.D.M. July 4th, 1921. (182,778.)
15,214. "Electric radiators and electric cookers." A. M. E. Beavan. May 30th, 1922. (197,553.)
15,460. "Electric condensers." W. H. Goodman and Dubilier Condenser Co. (1921), Ltd. June 1st, 1922. (197,556.)
16,068. "Electrical measuring instruments." L. N. Reddie. (Officine Meccaniche Italiane). June 9th, 1922. (197,561.)
16,161. "Telephone relays." Télégraphie Ges. System Stille and Dr. C. Stille. June 10th, 1922. (197,562.)
17,096. "Posts for supporting electric conductors and the like." G. B. R. Pimm. June 21st, 1922. (197,570.)
17,241. "Variable inductances and auto-transformers." E. Mallett and R. Marx. June 22nd, 1922. (197,572.)
17,802. "Mine-shaft signalling apparatus." W. B. Dale, R. A. Hopkinson, and J. Hopkinson & Co., Ltd. June 28th, 1922. (197,577.)
17,843. "Electric systems of connections for railway train units." British Thomson-Houston Co., Ltd. (General Electric Co.). June 28th, 1922. (197,578.)
18,932. "Spring-controlled electro-magnet armatures for electrical vibration regulators." Scintilla. July 20th, 1921. (183,445.)
20,459. "Device for use in supporting overhead conductor wires for electric railways and the like." Sir P. Dawson and F. W. Fawdry. July 26th, 1922. (197,587.)
20,825. "Electric switches." O. Lucas. July 29th, 1922. (197,590.)
23,646. "Electric storage batteries or accumulators." H. M. Geneve, G. R. N. Minchin, Pritchett and Gold, and E. P. S. Co., Ltd. August 31st, 1922. (197,599.)
23,759. "Lubrication of bearings." Metropolitan-Vickers Electrical Co., Ltd. September 30th, 1921. (186,595.)
24,921. "Field-magnet frames for dynamo-electric machines." J. Thum. October 22nd, 1921. (187,947.)
27,563. "Electrical transmission of sound." S. G. Brown. May 5th, 1922. (Divided application on 188,709.) (197,609.)
30,732. "Electric fuses." Switchgear & Cowans, Ltd., and E. D. Rodway. November 10th, 1922. (197,620.)

1923.

103. "Locking device for securing electric lamps to their holders." S. D. White and C. W. Saunders. January 1st, 1923. (197,626.)
4,123. "Electric switches." British-Thomson Houston Co., Ltd. March 25th, 1922. (195,355.)
8,597. "Machine-switching telephone exchange system." Coventry Automatic Telephones, Ltd. (F. R. McBerty). December 9th, 1921. (Divided application on 196,018.) (197,630.)